Railway Mechanical Engineer

Volume 93 | September, 1919 | No. 9

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The Labor Turn-Over

A discussion of the labor turn-over problem, which is of more than ordinary interest, will be found on another page of this number. It is not written by either an efficiency engineer, an expert employment officer, or an executive. There is nothing theoretical about it. The writer who had had considerable experience as a mechanic on a railroad, had gone into industrial work and then returned again to the railroad shop. His viewpoint is that of a mechanic. We hope that all of those foremen and other officers who control shop conditions will read it closely. Doubtless your shop is much better equipped than the one in which "Newt" had his experience. Fortunately, most railroads long ago awakened to the necessity for improving these conditions. On the other hand, even the best equipped shops may fall far short of the ideal in many respects. Good work cannot be done with a dull or inefficient tool. To get the best results from the workmen, conditions must be such as to emphasize the fact that the management is interested in their comfort and convenience, and is willing to do its full share in helping to make the conditions most favorable for good work.

The Valve Setter

There is no portion of the work incident to turning a locomotive out of shop that is of greater importance than the proper setting of the valves. A locomotive may have correctly proportioned grate area and draft appliances and be otherwise in first-class condition, yet will not give economical service if the valves are not so adjusted as to secure the maximum value of the steam supplied to the cylinders. The loss of efficiency, even with the increased fuel consumption that always occurs with poorly set valves, is of such proportions that the utmost care should be taken in doing this work. The valve setter, through incompetence or indifference, can destroy the possibility of securing the benefits that should be derived from a well designed and carefully constructed machine. Observations taken on a number of locomotives known to have improperly adjusted valves have shown an increase of from 15 to 20 per cent in fuel consumption. At the same time these locomotives have decreased in efficiency from 9 to 15 per cent. The setting of valves should be conducted with the utmost care and the instructions of the designers closely followed. The men doing this work should be selected not only for their general intelligence, but should be of the type who are exacting as to detail, as this is a matter of minute adjustment and a very slight deviation in setting the valve will cause wasteful results in the operation of the locomotive.

A Bright Spot in the Industrial World

Against the background of industrial unrest, suspicion and strife with which the conduct of the economic processes of the nation and the world is being beset, the resolutions adopted by the representatives of some 30,000 employees of the Midvale Steel & Ordnance Company, the Cambria Steel Company and their subsidiaries, in session at Atlantic City on August 22 and 23, stand out in strong relief. The opinion of these employees, expressed in the resolutions, is that "the persistent and unceasing demands of workingmen employed in all classes and kinds of industries for a shorter day's work and an increased rate in order to meet the present high cost of living is uneconomic and unwise and should not be encouraged." That these men have a keen appreciation of the real situation is evident from the reasons given for this opinion, namely, that "the price of commodities is regulated by the day's labor of a man and the real unit of value or the unit of compensation is not a dollar, but the purchasing power of a dollar, and that the

average price of commodities varies with the average compensation received for an hour's work by every man and every woman," and that the only sure remedy for the high cost of living is increased production and stabilization of prices in conformity with wages now being paid. It is significant that the employees of the Midvale and Cambria Companies are organized under one of the so-called industrial democracy plans to which reference has previously been made in these columns. While these resolutions are hardly sufficient evidence on which to claim the complete success of such plans, they are indicative of the sane attitude which may be expected from any group of workers when their relations with the employer are organized on a basis of open dealings and mutual freedom from suspicion.

Front End Inspection

The careful inspection of front ends of locomotives bears a very close and important relation to fuel consumption and should be given constant attention in roundhouse work. A frequent source of trouble and a serious cause of loss in steaming efficiency is leakage around the tubes in the front sheet. This was clearly demonstrated in the case of a locomotive selected for a series of tests of front-end arrangements. After a few trial trips with repeated failure of the locomotive to steam properly, even with the most careful firing by the best fireman on the division, an inspection of the front tube sheet disclosed numerous leaks, notwithstanding that a supposedly competent man had inspected the locomotive before the tests were begun. After these leaks were stopped a conservative estimate placed the saving in coal burned at approximately 1,000 lb. per hundred miles. At the price of fuel prevailing, this effected a considerable economy in fuel cost, as well as adding greatly to the efficiency, and consequently the earning power, of the locomotive. Other apparently trivial matters, such as poorly made joints between the exhaust stand and nozzle were found to have a very appreciable effect on the performance of the locomotive. The need of economy in these times of high prices of fuel and the necessity that the earning power of equipment be kept at the highest possible point warrant the most exacting inspection whenever possible between the regular inspection periods. This can readily be accomplished in the roundhouse, provided the men are each instructed that it is not only their job to make repairs as directed by their foremen, but also to report any defect that may come to their notice. Consistent co-operation of the mechanics and inspectors in the roundhouse will insure worth while results.

Car Department Problems

Changes in the application of the M. C. B. rules of interchange which take effect October 1, are such as to put the rules almost on a pre-war basis. The task of reorganizing the car department's forces and practices will not be an easy one, particularly in view of the changes in the personnel of the forces which have taken place during the past year or two.

The meeting of the Chief Interchange Car Inspectors & Car Foremen's Association at St. Louis, September 23-25, promises to be largely attended, and will, of course, be of more than ordinary interest because of these changing conditions. Like the Traveling Engineers' Association, the members of this organization concern themselves with an important and very highly specialized work. They are in daily touch with the practical application of the rules of interchange and with the detail problems of car operation and maintenance. Because of the radical changes which have taken place in the car department under wartime conditions, this organization or some other must also give early and thorough attention to the problem of recruiting the car department forces and of improving supervision in such a way as to insure that the workmen will be fully coached and educated as to how best to do their work.

The condition of the freight car equipment generally is very bad. During the war, material and labor conditions made it necessary to repair the cars only to such an extent as to keep them in service for the time being. The result of this policy, which, of course, was necessary, is now beginning to be felt, and the situation promises shortly to become acute. It demands immediate attention in a big way. Some car department officers are of the opinion that it will be necessary to have the deferred work done in outside repair shops. Others feel that with determination and support from above, the car department forces can be organized to do the work. Necessarily it will require heavy expenditures both for labor and material. When we consider what a breakdown in railroad operation may mean at this time in restricting national production and in preventing an earlier return to normal conditions, it would seem that those in authority would not long hesitate in taking the necessary steps to remedy this condition, no matter how high the cost may be.

The Traveling Engineers

Special importance attaches to the annual meeting of the Traveling Engineers' Association which will be held in Chicago, September 16-19. This organization has consistently confined its energies to the problem of improving locomotive operation, and from a purely practical standpoint alone has accomplished really remarkable results. Now it is faced with the question of deciding its future relationship to the American Railroad Association and particularly to Section III—Mechanical thereof. It is of vital importance—and this is not an exaggerated expression—in the interests of increased efficiency of operation for the railroads at large, that the action which is taken be such as to encourage and further intensify the good work which has been done so well by the Traveling Engineers' Association.

Efficient and economical locomotive operation is one of the keynotes to greater efficiency of railroad operation. The members of the Traveling Engineers' Association are largely men who are on the actual "firing line" on the road; a fact which is readily apparent to anyone who has attended the meetings of the association. These men know what they are talking about because of intimate contact with operating conditions. Because of this and because the nature of their work is such as to force them to express themselves clearly and concisely, and because they are educators and leaders in locomotive operation, their composite opinions and conclusions, as reached in conference, must carry real force and special weight.

Next in importance to deciding wisely upon the necessary changes in organization is the advisability of taking steps to insure making the personality and efforts of the traveling engineer, or whatever his title may be, more effective. It is, unfortunately, only too true on many roads that these men are handicapped and burdened with detail duties that largely prevent their being on the road as much as is desirable, or indeed necessary, for the best interests of the railroad. Men who are fitted by experience, ability and personality to educate and influence the enginemen to secure better results are being forced to give entirely too much of their time to clerical and other duties which could just as well be handled by men of less experience and not so well fitted for road work. They should not be required to assign power, despatch engines, keep up the force, assign crews and other work of this sort. Or if they are, then it should be clearly understood that they are not expected to do much road work, and steps should be taken to build up a special staff to do this work. No one will dispute the fact that it is necessary to have a competent staff on the road to supervise locomotive

operation; the trouble lies in the fact that many roads are fooling themselves into the belief that they have such a staff, while, in reality, although the men are carrying titles which indicate that they are responsible for the road work, they are actually spending little or no time on the road. This situation should be remedied.

Heat Treatment of Locomotive Forgings

The heat treatment of locomotive forgings was regarded as an important advance in locomotive construction when first introduced, but at the present time the practice seems to have fallen into disuse on many roads where it has been tried. Nevertheless the Master Blacksmiths' Association at its recent convention advocated the use of heat treatment wherever possible.

The statement has been made that heat treated parts have proved unreliable in service, and certainly during the period when heat treating was first used there were many failures that for the time being remained unexplained. These troubles from heat treated material were probably due to the effort to secure extremely high tensile strength by qurnching at a high temperature and drawing at a low temperature, making the steel liable to fracture. Furthermore, some manufacturers attempted to meet the demand for heat treated material by doing the work with inadequate equipment and inexperienced men. Considerable progress in the heat treatment of large forgings has been made during the war, and at present the manufacturers can furnish a much better product than formerly.

The successful use of heat treatment on automobile forgings has been pointed out as demonstrating the feasibility of improving the properties of locomotive forgings by heat treatment. The fact must not be overlooked, however, that large pieces cannot be cooled as rapidly as small pieces, and in driving axles or similar parts there is certain to be a considerable difference in temperature between the interior and exterior of the forgings. Experiments have demonstrated that large forgings subjected to the same heat treatment as smaller pieces of the same chemical composition show a lower elastic limit and lower tensile strength, usually accompanied by a slight reduction in the elongation and reduction of area. This effect is particularly noticeable in alloy steel. For example, a test piece of nickel chrome steel in the form of a five-inch cube quenched and drawn, showed an elastic limit of 125,000 lb. per sq. in., tensile strength of 134,000 lb. per sq. in., with elongation and reduction of area of 18, and 58 per cent respectively. A forging from the same ingot 12 in. in diameter, treated at the same temperature, showed an elastic limit of 74,500 lb., or approximately 60 per cent of the elastic limit shown by the test piece. The tensile strength of the forging was 109,000 lb. per sq. in., the elongation 15 per cent and the reduction of area 42 per cent. This shows conclusively that it is unreasonable to expect the same properties in locomotive forgings that are secured in the smaller parts used for automobiles.

To call attention to the benefit to be derived from the use of heat treated material would be superfluous. Heat treated material has proved satisfactory in all respects except uniformity of results and concerted action by the railroads, co-operating with the manufacturers, should eliminate the difficulties which have prevented the railroads from using it more extensively. Where forgings are to be made by the railroads it might be well to pay more attention to the heat treatment of carbon steel, with which the railroads' blacksmiths are more familiar. On the other hand, alloy steel should not be neglected. If more importance were attached to securing a high elastic limit with moderate reduction of area and elongation, it would no doubt be possible to obtain steel which would show uniform properties and yet be very satisfactory for use for locomotive parts.

The Issue Before the Shop Crafts

President Wilson and Director General Hines cannot be too strongly commended for the unequivocal stand they have taken on the question of wage increases in denying increases ranging from 17 to 27 cents an hour to railway shop men. The labor situation, complicated by the question of the relationship of an increase to the shopmen to the rates of other classes of railway employees and by the apparent difficulty with which the national leaders of the shopmen's unions were maintaining a reasonable degree of discipline in the ranks of their organizations, has thereby been greatly clarified. The issue is now clearly drawn. Are the shopmen's unions to pursue a course of selfishness which will defeat their own ends or will they display an enlightened self-interest which does not overlook the rights of the public and the national welfare?

Vigorous action has been taken by the Administration to arrest the upward trend of prices and to reduce the cost of living and it is probable that nothing is being left undone to accomplish everything in this direction which can be accomplished by corrective legal measures and concerted action of the administrative forces of the government. At the outset, however, results must be slow in appearing and until time has demonstrated what measure of success may be expected from the experiment, the least that each citizen or group of citizens can do is carefully to refrain from injecting any new disturbing elements into the situation. A lack of steadiness on the part of any group of the public will seriously jeopardize all efforts to bring the cost of living under control.

The fundamentals of this situation have evidently been clearly visualized by some of the organized railroad men themselves. The efforts to reduce living costs now being made by the federal government were strongly advised both by Warren S. Stone, president of the Brotherhood of Locomotive Engineers, and W. G. Lee, president of the Brotherhood of Railway Trainmen, who stated frankly that this was the real remedy rather than further increases in wages.

What then will be the position of the shopmen's unions if they vote to strike in an effort to enforce their demands for a general wage increase? First, they will have caused a serious interruption of transportation and distribution of the necessities of life. An irreparable economic loss will result. Prices of necessities will increase and there will be general suffering, in which the shopmen will participate. Second, this loss and suffering will be brought about to enforce demands which, should they be granted, will ultimately result in adding $800,000,000 a year to the country's transportation bill, starting a new cycle of increased wages and increased production costs, leading straight toward national disaster

And this will all be undertaken in direct opposition to the program advised by the leaders of other organizations of railroad men and will undoubtedly meet with the condemnation of these great bodies of the shopmen's fellow-workers.

These facts have all been placed before the men and will be considered by them in making their decision. They have also been clearly presented to the public and whether it be assumed that the President's statement was an appeal to public opinion, or merely voiced public opinion, it is reasonably clear what attitude the public will now take should the shopmen strike. Under such conditions, accompanied by the same firmness and unequivocal stand in dealing with the strike as that shown in dealing with the demands for a general wage increase, the prospects for success are practically hopeless.

The issue is clearly drawn. Will the men aid the nation in obtaining economic stability, in the benefits of which they will themselves participate, retaining thereby the honor and respect of the public? Or will they attempt to bring on chaos, thereby making themselves the enemies of society, with loss of influence and dishonor to themselves and their organizations? The country awaits the answer.

COMMUNICATIONS

INADEQUATE MAIN DRIVING BOXES

BROOKLYN, N. Y.

TO THE EDITOR:

Mr. Murdock's communication on inadequate main driving boxes which appeared in your issue of July, 1919, is interesting in that it draws attention to practices, at least a part of which have long been standard for long main boxes. His aversion to a constant spring thrust to maintain adjustment of wedges is not warranted or justified by the results obtained in service, as the automatic spring adjusted wedge has repeatedly demonstrated itself to be a most excellent device. It automatically takes care of expansion of the metals in driving boxes and maintains adjustment to compensate for wear of the faces of the shoe, wedge and box. That this is desirable with present box equipment there can be no doubt.

Mr. Murdock's reference to the taper of wedges is erroneous, the standard taper used by the American, Baldwin and Lima locomotive companies being one inch per foot. The angle of this taper is 4 deg., 47 min. According to good authorities, the angle of repose of smooth surfaces occasionally greased lies between 4 and 4½ deg. That is to say, the surfaces will slip at the angle mentioned. Therefore, somewhat more than sufficient spring thrust to sustain the weight of the wedge is necessary to take care of the piston thrust. In fact, the usual spring thrust, with the automatic wedge, varies between 1,600 lb. and 2,100 lb. The taper of the automatic wedge is 1 5/16 in. per foot.

When the pistons of a locomotive are moving in opposite directions, because the centers of the cylinders and the centers of the driving box bearings do not lie in the same transverse plane, the forces acting on the driving box bearings exceed the piston thrust in a ratio which is directly proportional to the ratio of the distances apart of these centers.

Assume that the distance between centers of driving boxes, in the four engines of the writer's tabulation, on page 174 of the April, 1919, issue is 42 in., and that the distance between the centers of the cylinders is 74 in. in the four coupled, 86 in. in the six coupled, 91 in. in the eight coupled and 95 in. in the ten coupled. The ratio, by which the piston thrust must be multiplied to obtain the pressure on the bearings of the main boxes is 74/42 in the four coupled, 86/42 in the six coupled, 91/42 in the eight coupled and 95/42 in the ten coupled.

Using the foregoing ratios and the piston thrusts given in the tabulation referred to above, lines 15 and 16 should read differently and a new line should be added as follows:

	Four-coupled	Six-coupled	Eight-coupled	Ten-coupled
Line 15—Box pressure, total, lb.	101,234	179,377	250,333	330,532
Line 16—Horizontal bearing pressure, lb. per sq. in.	1,349	2,174	2,782	3,390
Line 17—Ratio, horizontal to vertical bearing pressures	7.731	13.175	18.671	24.926

These figures are based upon full boiler pressure. It is fair to assume that the average M. E. P. of a freight engine in going over a division will be close to one-half boiler pressure, so we will divide the figures in line 17 by 2 and get the ratio of probable horizontal wear to probable vertical wear, which for the four-coupled engine is 3.865; for the six-coupled, 6.587; for the eight-coupled, 9.335; and for the ten-coupled, 12.463.

Now, the question arises: How can any one expect to maintain driving boxes, which wear in the horizontal direction, nearly 12½ times as fast as they do in the vertical direction? One should find no great difficulty, in arriving at the conclusion that this is a well nigh impossible proposition, even with crown bored brasses, as it has proved to be in practice.

Now, let us see just what the practice of crown boring referred to by Mr. Murdock would do for the ten-coupled engine. A safe figure for bearing pressure per square inch is 200 lb. in driving boxes of freight engines.

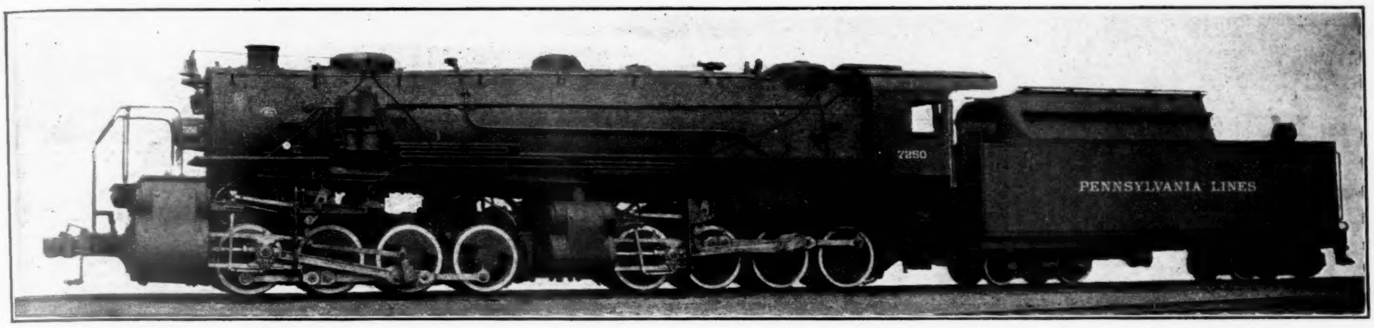
The live load on the main journal is 26,650 lb., and on the basis of 200 lb. per sq. in. we find that we may safely reduce the vertically projected area of the bearing to 133¼ sq. in. This calls for a crown bore 5 in. wide by 12¼ in. long, and in boring the crown we have reduced the bearing area in the horizontal direction, owing to the fact that the crown bore extends downward ½ in. If ½ in. full bearing is left on each end of the brass to prevent the escape of grease the projected bearing area in the horizontal direction is 91⅜ sq. in. Dividing 330,532 lb. by 91⅜, the bearing pressure per sq. in. is found to be 3,617 lb., and the ratio of probable horizontal wear to probable vertical wear becomes 9.042. This is a betterment of 27½ per cent at the start, but it must be remembered that as wear progresses the projected area of the crown bearing will be increased in area. At any rate, the improvement thus effected has been so entirely negligible that several roads have abandoned the practice.

The writer had no idea that the rearrangement of the bearing surfaces which he suggested in his former letter would go, as it has, practically unchallenged. The most obvious difficulty with the arrangement shown lies in the fact that a very slight vertical wear would throw the lower portion of the thrust brasses out of contact with the journal and render them useless, after which the box would wear open just as fast as the half-shell type. The writer believes, however, that there is no good reason why the box should not be made sectional, say in three pieces, one to embrace a crown brass and carry the weight, while cheek plates embracing thrust brasses would be arranged at the front and back of the journal in such manner as to take care of the thrust and pull from the piston. With a box of this description it would be necessary to interlock the pieces, so that they would be incapable of any movement relatively to each other, except that necessary to close and open the bearings. To take up slack and stop a pound, set up the wedge on the engine frame. When a pre-determined limit of take-up has been reached, put shims behind the brasses to restore the original box dimension, then set up the wedge as before. The writer can see no reason why an engine should ever be taken off its wheels except to true up the tires and journals, as the brasses could be slip fits in their recesses and could be renewed whenever necessary. The box could be removed from the frame without dropping the wheels or removing the rods. This should be convenient when taking up lateral motion.

Inadequate main boxes is a most important subject, relative to the maintenance of locomotives and the mere mention of it should provoke the liveliest of discussions. The writer sincerely hopes to see more of it in future issues of your valued paper.

CHARLES F. PRESCOTT.

NEW METAL ALLOY.—Trade Commissioner H. C. MacLean, at Rome, has sent a report to the Department of Commerce of a new alloy of zinc and copper which has been given the name of Biakametal. This alloy quickly demonstrated its usefulness in Italian industry, and by reason of its special qualities promises to attain similar success throughout the world. Metallurgists have made every effort to determine its exact composition, but without success. It is stronger than steel and less corrosive than copper. The most important characteristics are said to be the highest known breaking point, the highest limit of elasticity, perfect homogeneity, high resistance to thermic action and high resistance to chemical action.



Pusher Mallet Locomotive for the Pennsylvania Lines

PENN. LINES MALLET LOCOMOTIVE

For Pusher and Hump Yard Service; 51-in. Wheels and 28-in. Stroke; 100,000 lb. Tractive Effort

THE Pennsylvania Lines West of Pittsburgh has recently received from the Baldwin Locomotive Works 10 Mallet locomotives of the 0-8-8-0 type, which are designated by the railroad as Class CC-2-s. These locomotives are designed for heavy pusher and hump yard service and some idea of the severe conditions which they are required to meet is conveyed by the fact that they develop a tractive effort of 100,000 lb. The maximum grade in the hump yards on the Pennsylvania Lines is 3½ per cent, but the new Mallets are designed for operation on grades as steep as five per cent and on curves of 18 deg.

In the design of these locomotives there are a number of departures from well established Pennsylvania standards and in many respects the practice of the builders has been followed. The locomotives have conical wagon top boilers with radial stayed fireboxes instead of the Bellpaire type generally used on Pennsylvania power. The boiler has an outside diameter at the first ring of 88½ in., increased by the conical second course to an outside diameter of 100 in. at the throat sheet course. The firebox has an inside length of 144⅛ in. and is 96¼ in. wide. A barrel combustion chamber extends forward into the boiler 38½ in. from the vertical flange of the inside throat sheet. The tubes and flues have a length of 22 ft. and are 2¼ in. and 5½ in. in diameter, respectively. The boiler is also equipped with a 52-element Type A superheater.

Three rows of Baldwin expansion staybolts support the front end of the crown sheet. The arch is supported on five tubes and the locomotive is fired by a Duplex stoker. The throttle is of the inside connected type with the operating rod extending through the back head on the vertical center line; the throttle is equipped with an auxiliary drifting valve.

The wheels are of comparatively small diameter, measuring 51 in. over the tires and the low pressure cylinders are placed on an inclination of 1 in 35 in order to provide sufficient clearance above the rail. The high pressure cylinders are 26 in. in diameter and the low pressure 40 in. in diameter. A 28-in. stroke was made necessary by the small diameter of the drivers. Steam distribution is controlled by 14-in. piston valves for both the high and low pressure cylinders and the engines are fitted with the Simplex type of intercepting valve with auxiliary high pressure exhaust to the stack. The Walschaert valve motion is used throughout and the motion is controlled by the Ragonnet type *B* reverse gear.

The main driving axles have 10½-in. journals, while the journals of the other axles are 10 in. in diameter. All journals are 14 in. in length. The driving axles are of heat treated steel and are hollow bored. Heat treated steel is also used for the crank pins and the connecting and coupling rods. All driving tires are flanged.

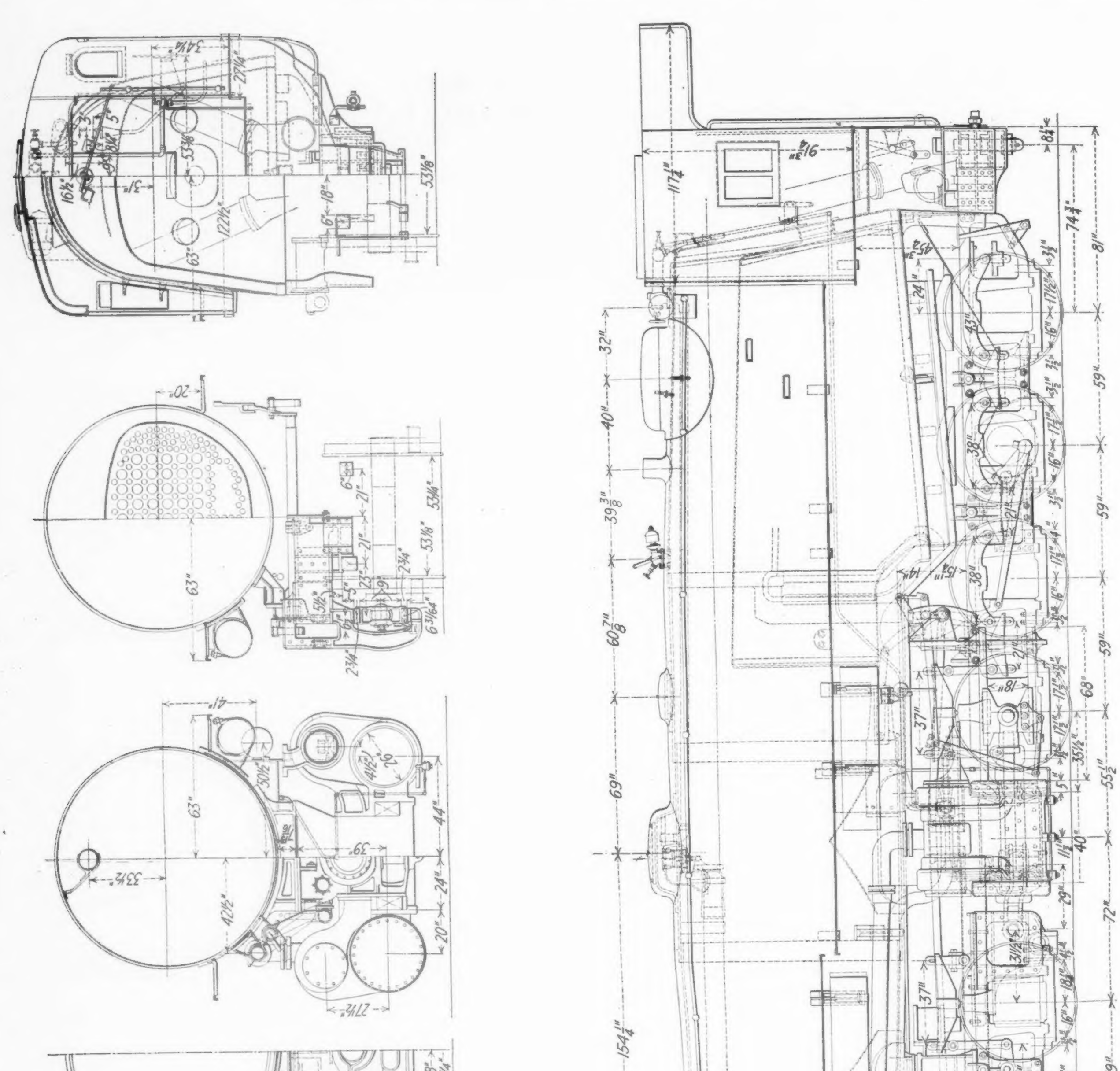
The equalization of the rear group of wheels is continuous on each side of the locomotive. In the case of the front group the springs of the leading wheels are cross equalized at the forward ends and attached to the frames at the rear ends. Those of the remaining three pairs of wheels are equalized together on each side.

Although the cab deck is roomy, the cab itself, in accordance with recent Pennsylvania practice, is comparatively short and the steam turret is placed outside and immediately in front of the cab. Two sand boxes are provided, one mounted over the first barrel course and the other above the firebox wrapper sheet just ahead of the cab. These are arranged to deliver sand to the rails at either the front or rear of each group of driving wheels.

The tender is built up with a one-piece cast steel frame and the tank is so designed that a water scoop subsequently can be applied if desired.

The following table presents the principal dimensions and data for these locomotives:

General Data	
Gage	4 ft. 8½ in.
Service	Pusher
Fuel	Bit. Coal
Tractive effort	100,000 lb.
Weight in working order	458,140 lb.
Weight on drivers	458,140 lb.
Weight of engine and tender in working order (est.)	650,000 lb.
Wheel base, driving	40 ft. 1½ in.
Wheel base, rigid	14 ft. 9 in.
Wheel base, total	40 ft. 1½ in.
Wheel base, engine and tender	78 ft. 8½ in.
Ratios	
Weight on drivers ÷ tractive effort	4.6
Total weight ÷ tractive effort	4.6
Tractive effort × diam. drivers ÷ equivalent heating surface*	714.4
Equivalent heating surface* ÷ grate area	74.1
Firebox heating surface ÷ equivalent heating surface,* per cent	5.5
Weight on drivers ÷ equivalent heating surface*	64.2
Total weight ÷ equivalent heating surface*	64.2
Volume equivalent simple cylinders	24.2 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	294.5
Grate area ÷ vol. cylinders	4.0
Cylinders	
Kind	Compound
Diameter and stroke	26 in. and 40 in. by 28 in.
Valves	
Kind	Piston
Diameter	14 in.
Wheels	
Driving, diameter over tires	51 in.
Driving, thickness of tires	3½ in.
Driving journals, main diameter and length	10½ in. by 14 in.
Driving journals, others, diameter and length	10 in. by 14 in.
Boiler	
Style	Conical
Working pressure	225 lb. per sq. in.
Outside diameter of first ring	88½ in.
Firebox, length and width	144⅛ in. by 96¼ in.
Firebox plates, thickness	Sides, back and crown, ⅜ in.; tube, ½ in.



Elevation and Cross Sections of Pennsylvania Lines 0-8-8-0 Mallet Type Locomotive

Firebox, water space	Front, 6 in.; sides and back, 4½ in.
Tubes, number and outside diameter	209—2¼ in.
Flues, number and outside diameter	52—5½ in.
Tubes and flues, length	22 ft.
Heating surface, tubes and flues	4,639 sq. ft.
Heating surface, firebox, including arch tubes	391 sq. ft.
Heating surface, total	5,030 sq. ft.
Superheater heating surface	1,406 sq. ft.
Equivalent heating surface*	7,139 sq. ft.
Grate area	96.3 sq. ft.
Tender	
Tank	Water bottom
Frame	cast steel
Weight (estimated)	192,000 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	20 ton

*Equivalent heating surface = total evaporative surface + 1.5 times the superheating surface.

LAME ENGINES AND THEIR EFFECT ON FUEL CONSUMPTION*

BY J. W. HARDY
Fuel Supervisor, United States Railroad Administration

The purpose of this paper is to show in a practical way how fuel is wasted by lame engines (engines with valves out of adjustment). With this end in view tests were made on the Southern Pacific between Houston and Galveston.

The engines used were of the following dimensions:

Engine 267 was of the 4-4-0 type having a total weight of 137,425 lb., weight on drivers 91,675 lb. and tractive effort of 21,240 lb. The cylinders were 20 by 24 in. The valves 12 in. diameter inside admission piston type. The valve motion was the Stephenson link, set as follows: valve travel 6 in., 1⅛-in. lap, 3/32-in. exhaust clearance, line and line in front motion and ⅛ in. lead in back motion.

The engines were equipped with superheaters and burned fuel oil.

Engine 265 was of practically the same design and dimensions with the exception that the cylinders were formerly equipped with slide valves which were replaced with piston valves, simplified steam chests with 10 in. diameter valve outside admission having 1-in. lap, 1/32-in. lead in forward motion, 1/32-in. back, and 1/16 in. exhaust clearance.

The engines in these tests were run eight trips in each case with one exception, test No. 2. The test was conducted with Engine 267, which had considerable lost motion in its valve gear, and had made 16,700 miles since last shopping. Engine 265 was in the best of condition, having been turned out of the shops after being generally overhauled and superheated. The same engineer and fireman were used throughout the entire test.

The tests made numbered from 1 to 6 inclusive—test Nos. 1 to 3 with engine 267 and 4 to 6 with engine 265. There were many places where we could get the lame engine, but we could not get the other conditions necessary to prove waste due to improper valve adjustment. We thought it was easier, better and more reliable to make changes on the engine than to attempt to work out the other conditions, many of which we had no control over.

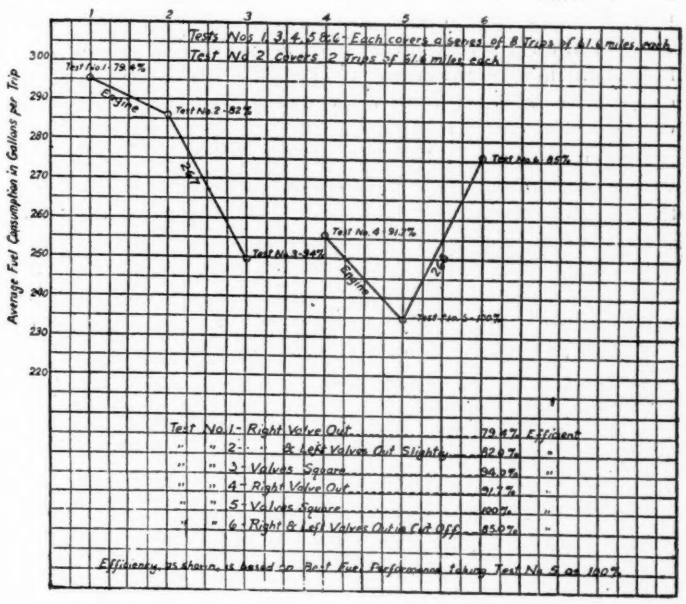
The objects of the tests were to determine the fuel wasted by locomotives with valves out of adjustment, and to see how lame a locomotive could be without loss of time or complaint on its condition. Where an engine is so lame it cannot make time or handle its tonnage, it immediately attracts the attention of the transportation department and is taken in and repaired. It is only in rare cases that engines go lame all at once. When this occurs there is usually something lost, slipped or broken. This is noticed at once and is taken care of at the earliest possible moment; but, where the change takes place slowly and gradually, as it does by age and wear, we become more and more accustomed to it, and it is allowed to go on day after day and week after week wasting fuel all the time.

*Abstract of a paper read before the International Railway Fuel Association at the convention in Chicago, May 19-22, 1919.

An oil burner was selected because a more accurate check could be made of the fuel used than with the coal burner. Measurements were taken just before starting, and on arrival, so that oil and water used represents what was actually used in pulling the train and making station stops. All conditions of engines and service were kept as near the same as possible, except the valve adjustment, which is shown at the heading of each test made.

There was a total of 5/16 in. lost motion in the valve gear of engine 267, but this was pretty well distributed, the engine not lame enough in any case to affect the schedule of the train. There was a noticeable kick in the engine when lame that was not there when squared.

With the slight change in valve adjustment shown between tests 1 and 3, there was a difference of 18.33 per cent in the fuel consumed; no other charge can be made of this loss of fuel than to the condition of valves. The waste would undoubtedly increase with heavier service or more distorted valve condition; this is proved by test No. 6 with engine 265. Test No. 2 is not recorded for the purpose of comparison, but to show the condition of valves after the engine was squared up by the travel at full stroke and pronounced O. K.



Relation of Fuel Consumption to Valve Setting

More throttle had to be used with the engine in this condition than when the valves were as in test No. 3.

The valves govern the application of the power of steam to the locomotive and are of great importance to fuel consumption. It takes fuel to generate power, and it means a waste of fuel if this power is improperly used in the cylinders of our locomotives. The exhaust action is different when the engine is lame, causing a pulsating draft instead of a regular and constant pull on the fire. This wastes fuel in addition to the improper application of the power to the machine. Square engines steam better than lame ones, although these engines steamed well in both cases.

Valves out of square in a measure take the economical operation of the locomotive out of the hands of the crew. Their hands are practically tied because they are robbed of the control of the power applied to the locomotive in their charge. With an indifferent crew this loss will increase.

There is no way that we know of where we can get as good returns, and get them as quickly and at as little cost, as by squaring valves. It only costs a few dollars more to do

this work well; it only costs a few dollars to do it at a time when it is needed and should be done, and it will often begin to pay dividends the first trip after it is done. Transportation people should want it done because the engine will pull more and pull out less draw bars when square than when lame, because the power is more evenly distributed in the cylinders and helps to prevent lunging and jerking when starting. The mechanical department people should do it because it cuts down fuel waste and the cost of locomotive maintenance. The crew should want it done because it makes their work easier and more pleasant.

There is liable to be less complaint on a lame oil burner, especially if she steams, than on a coal burner on account of less manual labor to fire the oil burner. Why spend money for brick arches, superheaters, etc., and then waste as much with valves out as we can save with both of them? Why spend money to generate steam and then not control its use? You can go to any union station or large freight yard and hear engines pulling out every day on long, hard and heavy runs that sound worse than either of these engines did. The question of proper valve adjustment is so important that it should be specialized on.

The cut-off and steam distribution on test No. 2 with engine 267 merits careful study. This engine was run over at full stroke; in fact, was more carefully gone over than this work is usually done; pronounced O. K., and, no doubt, under ordinary circumstances, would have run possibly for months in this condition. Note how much better this engine did in test No. 3 with valves properly adjusted and a little of the lost motion taken up.

The difference in the performance of engine 267 with valves lame and square was so much we decided to make a test with an engine having as little lost motion in the valve gear as possible. We therefore arranged for a test with engine 265. This engine was new, and when broken in the right go ahead blade was changed so the cut-off was as shown in test No. 4. This engine was quite lame only on one side, and this low down in the quadrant, and, as the lever was hooked up, it got better. As the engine did most of its work at close cut-off, this change only made a difference of about 9¼ per cent in the fuel used, but the engine had a very disagreeable kick on the right side when run at high speed and short cut-off.

Certain kinds of lameness are more wasteful than other kinds. The engine that is lame where it uses the most of its steam is the most wasteful. This is clearly brought out by test No. 6 with engine 265. By changing the back motion blades so that the engine cut-off in the forward motion, this engine was made lame in the cut-off where most of its work was done.

In all tests where the engines were lame, the lameness was aggravated by its being more difficult to keep the valves lubricated, and both engines rode much harder while lame than when squared. An engine can sound square and still have valves improperly set. A condition of this kind can only be discovered by careful measurements.

My conclusions from these tests are that a waste of as much as 25 per cent of the fuel could be made by further distortion of valves before the engines would begin to lose time or affect the train service.

CONDITIONS SURROUNDING TESTS NOS. 1 TO 6, INCLUSIVE, WITH CUT-OFF AT 6-IN. PISTON TRAVEL.

Test No. 1, Engine No. 267. Right valve out—cut-off—right side, front 5$\frac{1}{16}$ in., back 10$\frac{3}{16}$ in. Left side, front 7¼ in., back 7¾ in.

Test No. 2, Engine No. 267. Both valves out—cut-off—right side, front 7$\frac{1}{16}$ in., back 5$\frac{1}{16}$ in. Left side, front 7$\frac{1}{16}$ in., back 5$\frac{3}{16}$ in.

Test No. 3, Engine No. 267. Both valves square.

Test No. 4, Engine No. 265. Right valve out—cut-off—right side, front 8½ in., back 3½ in. Left side, front 6½ in., back 6$\frac{13}{16}$ in.

Test No. 5, Engine No. 265. Both valves square.

Test No. 6, Engine No. 265. Both valves out—cut-off—right side, front 3$\frac{11}{16}$ in., back 8$\frac{7}{16}$ in. Left side, front 4⅛ in., back 7$\frac{13}{16}$ ni.

Per cent increase in fuel consumption Test No. 1—18.33 per cent.

Per cent increase in fuel consumption Test No. 2—14.63 per cent.

Per cent efficiency of engine in Test No. 1, considering engine in Test No. 3 as 100 per cent—84.5 per cent.

Per cent efficiency of engine in Test No. 2, considering engine in Test No. 3 as 100 per cent—84.5 per cent.

Per cent increase in fuel consumption Test No. 4—9.12 per cent.

Per cent increase in fuel consumption Test No. 6—17.70 per cent.

Per cent efficiency of engine in Test No. 4, considering engine in Test No. 5 as 100 per cent—91.6 per cent.

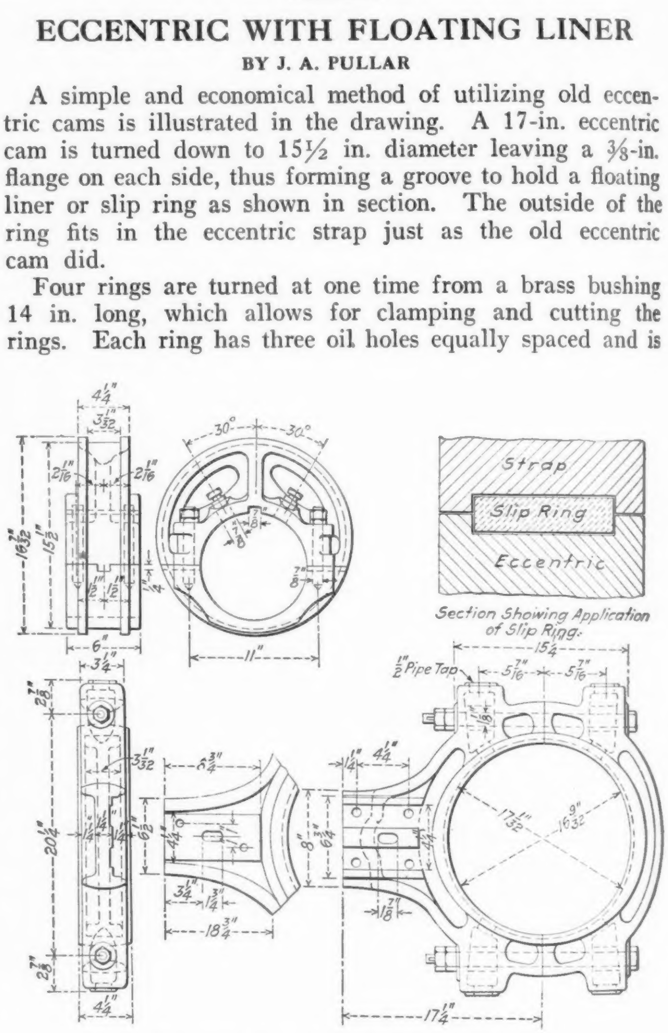
Per cent efficiency of engine in Test No. 6, considering engine in Test No. 6 as 100 per cent—84.9 per cent.

ECCENTRIC WITH FLOATING LINER

BY J. A. PULLAR

A simple and economical method of utilizing old eccentric cams is illustrated in the drawing. A 17-in. eccentric cam is turned down to 15½ in. diameter leaving a ⅜-in. flange on each side, thus forming a groove to hold a floating liner or slip ring as shown in section. The outside of the ring fits in the eccentric strap just as the old eccentric cam did.

Four rings are turned at one time from a brass bushing 14 in. long, which allows for clamping and cutting the rings. Each ring has three oil holes equally spaced and is



Eccentric Cam With Slip Ring in Place

cut in three parts on a milling machine by cutting through the center of the oil holes.

The eccentric cam can be turned down to fit the rings in the same length of time it would take to fit a new cam on the journal and considerable machine work and labor is avoided by using the old cam.

Eccentric cams converted as described have proved very successful and wear longer than when applied in the old way. The use of the ring has eliminated the usual trouble of closing the eccentric strap after every few trips and when worn the ring may be renewed in a very short time, while it would take several hours to fit a new eccentric cam and key.

CAR DEPARTMENT FORCES TO BE INCREASED.—On account of the fact that the number of bad order cars has increased considerably at the Nashville shops of the Nashville, Chattanooga & St. Louis, the forces in the car department are to be materially increased. It is understood that the additional men needed to put these cars in good condition for shipping will be drawn from the ranks of those recently laid off.

Shopmen's Wage Increase Refused

President Agrees with Director General that Demands Are Unjustified Under Present Conditions

THAT there shall be no new cycle of wage increases for railroad employees under present conditions is the decision of President Wilson and Director General Hines on the demands presented by the committee of the shopmen's unions. This conclusion was reached on the ground that the increases already granted by the Railroad Administration and by the railroad companies during the two years preceding federal control have kept pace with or exceeded the increase in the cost of living up to date, and that further advances in railroad wages are not warranted by comparison with other wages, and would merely result in a further increase in the cost of living, which the government is now bending every effort to reduce.

Whether this decision will be accepted by the labor organizations, however, will not be known until the counting of the new strike vote called for by the leaders following their formal rejection of the small increase granted the men by way of readjustment.

Following the submission to Congress by President Wilson on August 1, of his recommendation for legislation creating a tribunal for the investigation and determination of all questions concerning the wages of railway employees, the responsibility for settlement of the questions arising from the shop crafts' demands was placed squarely on the shoulders of the President and Director General by the unanimous decision of the Senate committee on interstate commerce that the President already possessed "complete and plenary authority" in the premises.

Therefore, on assurances that the 40,000 men estimated by union officials in Washington to have walked out in the unauthorized local strikes following the reference of the wage question to Congress, had returned to work, conferences were resumed on August 20 between the shop employees' representatives, headed by B. M. Jewell, and the Railroad Administration. On August 23 Director General Hines gave the President a complete report of his recommendations for a settlement and on August 25 the shopmen's committee, which had just completed the count of a vote authorizing the calling of a strike unless their demands were granted, was called to the White House to receive the final decision from the President. The shop employees were awarded an increase of 4 cents an hour, retroactive to May 1, more as an adjustment than as a direct wage increase.

At this conference a copy of Mr. Hines' report, and two statements by the President, one to the shopmen and one to the public, were given out.

THE PRESIDENT'S STATEMENT TO THE PUBLIC

In his statement to the public, President Wilson briefly reviewed the steps by which the settlement had finally been placed in his hands, then taking up the grounds on which the men had justified their demands. In discussing the high cost of living in this connection he made a strong plea for sober second thought on the part of all wage earners to the end that adjustments to meet living costs be postponed until normal conditions are restored and adjustments can be made on a more certain basis.

"Demands unwisely made and passionately insisted upon at this time," the President said, "menace the peace and prosperity of the country as nothing else could, and thus contribute to bring about the very results which such demands are intended to remedy."

THE PRESIDENT'S STATEMENT TO THE SHOPMEN'S COMMITTEE

In addressing the Committee of the shopmen's unions the President said:

I request that you lay this critical matter before the men in a new light. The vote they have taken was upon the question whether they should insist upon the wage increase they were asking or consent to the submission of their claims to a new tribunal, to be constituted by new legislation. That question no longer has any life in it. Such legislation is not now in contemplation. I request that you ask the men to reconsider the whole matter in view of the following considerations, to which I ask their thoughtful attention as Americans, and which I hope that you will lay before them as I here state them.

We are face to face with a situation which is more likely to affect the happiness and prosperity, and even the life, of our people than the war itself. We have now got to do nothing less than bring our industries and our labor of every kind back to a normal basis after the greatest upheaval known to history, and the winter just ahead of us may bring suffering infinitely greater than the war brought upon us if we blunder or fail in the process. An admirable spirit of self-sacrifice, of patriotic devotion, and of community action guided and inspired us while the fighting was on. We shall need all these now, and need them in a heightened degree, if we are to accomplish the first tasks of peace. They are more difficult than the tasks of war—more complex, less easily understood—and require more intelligence, patience and sobriety. We mobilized our man power for the fighting, let us now mobilize our brain power and our consciences for the reconstruction. If we fail, it will mean national disaster. The primary first step is to increase production and facilitate transportation, so as to make up for the destruction wrought by the war, the terrible scarcities it created, and so as soon as possible relieve our people of the cruel burden of high prices. The railways are at the center of this whole process.

The government has taken up with all its energy the task of bringing the profiteer to book, making the stocks of necessaries in the country available at lowered prices, stimulating production, and facilitating distribution, and very favorable results are already beginning to appear. There is reason to entertain the confident hope that substantial relief will result, and result in increasing measure. A general increase in the levels of wages would check and might defeat all this at its very beginning. Such increases would inevitably raise, not lower, the cost of living. Manufacturers and producers of every sort would have innumerable additional pretexts for increasing profits and all efforts to discover and defeat profiteering would be hopelessly confused. I believe that the present efforts to reduce the cost of living will be successful, if no new elements of difficulty are thrown in the way, and I confidently count upon the men engaged in the service of the railways to assist, not obstruct. It is much more in their interest to do this than to insist upon wage increases which will undo everything the government attempts. They are good Americans, along with the rest of us, and may, I am sure, be counted on to see the point.

It goes without saying that if our efforts to bring the cost of living down should fail, after we have had time enough to establish either success or failure, it will of course be necessary to accept the higher cost of living as a per-

manent basis of adjustment, and railway wages should be readjusted along with the rest. All that I am now urging is, that we should not be guilty of the inexcusable inconsistency of making general increases in wages on the assumption that the present cost of living will be permanent at the very time we are trying with great confidence to reduce the cost of living and are able to say that it is actually beginning to fall.

I am aware that railway employees have a sense of insecurity as to the future of the railroads and have many misgivings as to whether their interests will be properly safeguarded when the present form of federal control has come to an end. No doubt it is in part this sense of uncertainty that prompts them to insist that their wage interests be adjusted now rather than under conditions which they cannot certainly foresee. But I do not think that their uneasiness is well grounded. I anticipate that legislation dealing with the future of the railroads will in explicit terms afford adequate protection for the interests of the employees of the roads; but, quite apart from that, it is clear that no legislation can make the railways other than what they are, a great public interest, and it is not likely that the President of the United States, whether in possession and control of the railroads or not, will lack opportunity or persuasive force to influence the decision of questions arising between the managers of the railroads and the railway employees. The employees may rest assured that, during my term of office, whether I am in actual possession of the railroads or not, I shall not fail to exert the full influence of the Executive to see that justice is done them.

I believe, therefore, that they may be justified in the confidence that hearty co-operation with the government now in its efforts to reduce the cost of living will by no means be prejudicial to their own interests, but will, on the contrary, prepare the way for more favorable and satisfactory relations in the future.

I confidently count on their co-operation in this time of national test and crisis.

DIRECTOR GENERAL HINES' REPORT

Mr. Hines' report to the President, dated August 23, is as follows:

In view of the importance both to the railroad employees and to the public of the wage demands of the shop employees, and in view of the intimate relationship between that subject and the all-important subject of the cost of living, I feel it my duty to make this report to you for action by you if you wish to take personal action in regard to it.

The responsibility rests upon me to decide upon its merits the claim of the railroad shopmen for the following increases in wages:

	Now receiving Cents	Requested Cents	Increase Cents
Machinists	68	85	17
Toolmakers	68	90	22
Boilermakers	68	85	17
Riveters	68	85	17
Blacksmiths	68	85	17
Sheet metal workers	68	85	17
Electricians	68	85	17
Car inspectors	58	85	27
Car repairers	58	85	27
Car repairers, steel	63	85	22
Helpers	45	60	15

Note.—These figures represent only the principal classes.

This demand was considered by the Board of Railroad Wages and Working Conditions, a board constituted last year by the Railroad Administration to consider wage matters, and consisting of three representatives of labor and three representatives of the railroad managements. On the question of any general increase to the shopmen, the board divided equally, the three labor members favoring an increase to a basis of 80 cents and the three management members opposing any general increase whatever, although expressing the opinion that unless the cost of living could be controlled, there would need to be a further general increase in wages. This is the first time when this board has thus divided on the question of a general wage increase presented to it. In every other case the board has been in agreement upon the proposition that there ought to be a general increase, although in some cases its members have been slightly apart as to the extent of the general increase. In this case three members of the board, who in all other cases have been in favor of a general increase, have thus opposed any increase whatever for the entire class of employees.

I believed it would be more satisfactory both to the employees and to the public to have this grave problem considered and disposed of by a commission created by new legislation. Recommendation to that effect was submitted to the appropriate committees of the Senate and the House, but the unanimous adverse action of the Senate committee made it clear that such a course would not be pursued.

It is also true that the employees themselves vigorously objected to my suggestion and insisted that the matter should be decided by me.

Since the subject must be dealt with, and no other method has been or is to be provided, it follows that it must be dealt with by the director general under the powers conferred upon the President by the Federal control act, and this must be done without the aid of any action by the wage board.

I approach this matter with the clearest conviction that the railroads must be conducted now and for all time in the future in such a way as to give to railroad employees an adequate compensation and a liberal share in the returns from railroad operation. This is not only justly due to the employees who make possible the rendition of the service but it is obviously in the interest of good service. It is true now, and will be true to a continually increasing extent in the future, that a state of contentment on the part of railroad labor will be indispensable to efficient railroad service and this contentment cannot exist unless the evidence of fair treatment is so clear that it will carry conviction to the railroad employees themselves.

I have, after the most careful possible study, and after considering everything presented on behalf of the railroad shop employees, reached the following conclusions:

The main contention of the shop employees is that their demands are just because of the rates paid in the ship yards, navy yards and arsenals. The basic rate in the ship yards was 80 cents at the time the shopmen presented their demands, and an increase effective October 1 next has just been made in an agreement (to which the government was in no way a party) between the employees and the ship builders on the Pacific coast. After the most careful consideration, I can see no escape from the conclusion that the rates paid in the shipyards cannot be adopted as a measure for the rates to be paid in the railroad shops. The conditions are fundamentally different. The work performed by employees classed as railroad shop employees is performed in every city and in every railroad town of considerable size in the United States. The principal railroad shops are not in the largest cities and many of the principal shops are in towns or cities of relatively small size. At the urgent instance of the employees, the rates for all these shopmen throughout the United States, whether in large cities, small cities or towns or virtually rural communities, have been standardized on uniform bases. It cannot be, therefore, that these standardized rates can be put so high as to reflect the conditions prevailing in the relatively few industrial centers where shipbuilding was developed under high pressure during the war. Not only are the shipyards practically without exception in densely populated centers but employees had to be attracted to those yards in time of war in competition with munition plants and others paying exceptionally high wages, and the employees who

were attracted to those yards had to establish themselves in these densely populated centers with particularly costly living conditions. In order to meet the keen competition of other war industries and to build up the forces of men in the shipyards exceptional rates had to be provided.

The work in the railroad shops not only offers year in and year out (despite the fluctuations incident to changes in the volume of business) reasonably steady employment, but also offers a practically permanent career. On the other hand shipbuilding represents to a large extent a temporary employment. This is brought out clearly by the following showing which is actual up to August 15, 1919, and estimated beyond that date, as to the employees who have been and will be employed in the shipyards so far as the present governmental program is concerned.

Date	Number of shipbuilders	Date	Number of shipbuilders
January, 1914	48,700	June, 1919	354,625
January, 1916	78,100	Dec. 31, 1919	250,894
January, 1918	144,600	June 30, 1920	230,000
November, 1918	373,622	Dec. 31, 1920	153,000
January, 1919	361,211	June 30, 1921	0

Note.—These figures do not include, as I understand it, members of office forces, but only include the men engaged in ship construction and men employed in fabricating shops and all other shops actually a part of the shipyard plant.

It is perfectly clear to me that the people of the United States cannot be committed to the policy that the wages of railroad shopmen in every city, town and village in the United States must be brought up to a basis created in an emergency and in a largely temporary war undertaking, concentrated in a comparatively few densely populated industrial centers where living conditions are exceptionally expensive and difficult, so that I conclude that the principal contention of the shop employees cannot be adopted.

Of course if the employees themselves were willing to accede to a plan whereby the wages of railroad shopmen in each community should be made with reference to the average wages in that community, other considerations would have weight. But the employees are insistent that the same wage scale shall be paid in every place in the United States, regardless of its size or of local living conditions, and as this principle has been adopted it necessarily follows that exceptional conditions in exceptional communities cannot be taken as the standard for the wages of railroad shopmen.

The conditions in the navy yards and arsenals cannot, largely for the reasons already stated, be taken as controlling; moreover, it has generally been recognized that the rates therein should reflect local conditions in the particular communities and they have not been standardized at all except for a temporary standardization for the war to correspond with the shipyard rates.

It is further urged by the employees that the rates they receive are below those paid in private industries for similar labor. The employees cite various instances of rates in excess of 80 cents for work of this character, but these citations merely refer to conditions in specific communities. It must also be remembered that to a large extent private industries themselves were influenced to an exceptional degree by the war conditions, enjoying the most exceptional profits and paying unusually high wages to meet emergency requirements. But no convincing evidence has been presented that the average of the wages paid in private industries generally, or in those paying union scales of wages, throughout the United States for similar labor was or is substantially higher than the rates paid by the Railroad Administration.

I myself have collected the available information from the Department of Labor and that indicates that the average rate paid the principal metal trades in private industries, having union scale of wages, was at May 15, 1919, probably not more than 3 cents in excess of the 68 cent rate paid to the railroad shop employees. It is a question whether even as to private industries the advantages of work in railroad shops, including the advantage of substantial amounts of free transportation, do not make it reasonable for the railroad shops to have a differential under the rates paid in other private industries. This question, however, need not be decided because the decision made below will make the rates for the railroad shop employees in excess, if anything, of average rates shown in the evidence thus obtainable from the Department of Labor for private industries.

In making comparisons for work of similar character between wages in the railroad industry and wages in private industries, due consideration must always be given to the fact that private industries are frequently able to increase their prices to the public without difficulty to offset, and more than offset, increases in wages, so that to a very considerable extent the wages fixed in private industries are fixed without any representation, either direct or indirect, of the general public which eventually must pay the bill. On the contrary the railroads whether under public or private control cannot increase the prices they charge, i.e., their transportation rates, except with the sanction of public authority. So the question must be viewed from the public standpoint as well as from the standpoint of the employees. This necessitates the most careful scrutiny of rates of pay which have been fixed by industries enjoying tremendous profits which are not subject to public control. Of course the wages paid railroad employees must be not only reasonable in themselves but reasonably satisfactory to the employees, and necessarily the general average rates normally paid elsewhere in permanent private industries for similar services, are an important factor for consideration. But the distinguishing conditions must never be ignored.

The further claim is made that the cost of living has increased. In a letter of August 5, 1919, signed by the executives of the six railroad shopmen's organizations, and also by the executives of the eight other organizations of railroad employees, including the various organizations of train and engine men, of telegraphers, maintenance of way men, and clerks, the proposition is laid down that railroad employees are entitled to compensation which will, at least, re-establish the pre-war purchasing power of their wage.

The way to re-establish the pre-war purchasing power of wages is to reduce the cost of production and not to increase it.

The government is now taking vigorous steps to reduce the cost of living and is meeting with gratifying progress. This great work would be arrested if not defeated through the present adoption of the policy of moving up wages so as to reflect fully what is probably the very top-notch of the high cost of living. Such a movement would tend to increase still further the cost of living and injure every working man as well as every other person in this country.

In a statement presented to the President on July 30, W. S. Stone, president of the Brotherhood of Locomotive Engineers, said:

"We believe the true remedy for the situation, and one that will result in lifting the burden under which the whole people are struggling is for the government to take some adequate measures to reduce the cost of the necessaries of life to a figure that the present wages and income of the people will meet. Should this not be considered feasible, we will be forced to urge that those whom we represent be granted an increase in wages to meet the deterioration of the purchasing power of the dollar, be that what it may, which can be easily determined by competent authority."

W. G. Lee, president of the Brotherhood of Railroad Trainmen, in a summary of a statement made by him before the Board of Railroad Wages and Working Conditions and given to the press by him on July 31, stated that an increase

in wages was not the proper solution of the present economic stress under which working men are laboring because they will be followed by new increases of cost of everything which would more than absorb the additional pay.

I therefore believe it would be unfair for the general public, subversive of the efforts which the government is making to reduce the cost of living, and injurious to railroad employees themselves, for the Railroad Administration at this time to adopt the principle of moving up wages of all railroad employees so as to reflect the highest point yet reached in the high cost of living. Such action would mean inevitably an increase in freight rates which would stimulate an increase in the cost of everything consumed by the public and would give innumerable pretexts for covering up additional unwarranted increases in prices on the claim that such increases will be necessitated by the increased cost of railroad transportation. As a matter of fact the rates of pay and also the earnings of many subdivisions of classes of railroad employees have already been so advanced as to be ahead of the highest point yet reached in the general average increase in the cost of living in the country. Any effort to adopt that high point as the minimum level for all railroad wages will be highly detrimental to the public interest.

I have consistently urged throughout this calendar year that the greatest problem before the country is a reduction in the cost of living and one of the greatest obstacles in the way of such reduction would be substantial increases in transportation rates. I am convinced that it is not reasonable from the standpoint of the public and would not be beneficial from the standpoint of railroad employees to make an increase in wages in the effort to overtake the high cost of living, since the increase would thereby result in putting cost of living further out of reach and seriously obstruct the efforts now being made to bring down the cost of living.

In this connection it is proper to say that if railroad shop employees be viewed as a class it appears from the best data available that, comparing the total earnings of those employees now with their total earnings in the year ending June 30, 1915, the average increase in their earnings is somewhat in excess of the total increase in the cost of living from July 1, 1915, to August 1, 1919. This comes about by the fact that in carrying out the policy of standardization so strongly urged by the railroad employees great numbers of men employed in railroad shops were given the benefit of a higher classification which entitled them to wages much in excess of the increases indicated by the mere difference between the old rates of pay and the new rates of pay. While it is true that those railroad shop employees who enjoyed the highest scale of wages prior to the war may not have received an increase fully commensurate with the increase in the cost of living it is also true that great numbers of those employees have received increases substantially in excess of the increase in the cost of living. This condition however should afford no basis for the claim that the total increase already given to railroad shop employees is excessive, because I do not believe that such is the case. On the contrary, I believe the railroad shop employees were fairly entitled as a whole to the increases in wages provided and are also fairly entitled to the additional increase next below mentioned.

There has been insistent contention that while all other classes of railroad employees have had their wages adjusted in such manner that they receive an increase wage in addition to receiving 10 hours' pay (in the pre-war period) for eight hours' work, this same treatment was not accorded to the shopmen. While it has been urged with equal insistence that the shopmen got offsetting advantages, it seems to me it is true that in this specific matter the shopmen did not receive the benefit of equal treatment. On that account it seems to me fair in all the circumstances to recognize this condition by giving the shop employees a rate of 72 cents instead of 68 cents for the classes now receiving 68 cents.

Under Supplement 4 to General Order 27 and an addendum to that supplement, two different rates have been provided for car repairers, one a rate of 63 cents for steel freight car repairmen and another rate of 58 cents for wooden freight car repairmen. This distinction has been difficult to maintain and has been the source of dissatisfaction and there is general agreement among the members of the wage board that the condition ought to be remedied (although the labor representatives think it ought to be remedied by increasing the rates for all car repairers to the highest rates).

I therefore conclude, that, except as stated below, the rate for all freight car repairmen who by Supplement 4 to General Order 27 and the addendum thereto were intended to receive either 58 cents or 63 cents shall receive 67 cents per hour. There has been great dissatisfaction because car inspectors generally have received only the rate of 58 cents notwithstanding the fact that steel freight car repairmen have received the rate of 63 cents. My conclusion is that, except as below stated, car inspectors should receive the same rate as above indicated for freight car repairmen and therefore should receive 67 cents per hour.

The exceptions above referred to as to freight car repairmen and as to car inspectors are as to such employees at outlying points other than shops and main line terminals at which points the work, generally speaking, is not continuous. The increase for freight car repairmen and car inspectors at such outlying points will be 4 cents per hour. The determination as to the points where the freight car repairmen and car inspectors who according to this principle get only the 4 cents increase will be taken up in conference with the representatives of the shopmen with a view to arriving at a reasonable and definite working rule.

As to all other classes covered by Supplement No. 4 and not above specifically dealt with, the rate of increase shall be 4 cents per hour.

Ever since last September it has been the settled principle of the Railroad Administration to make wage orders retroactive to a date approximating the date upon which the Board of Railroad Wages and Working Conditions made its report and in this instance that report was made on July 16. The conditions here, however, are peculiar in that the action of the wage board has been delayed for an exceptional length of time, the presentation to the wage board having been made last February. In these circumstances it seems to me that, as a part of a negotiation of a national agreement, the changes above indicated could properly be made effective as of May 1, 1919, and the Railroad Administration is willing to make these changes in rates of pay effective as of that date for all employees who do not leave the service pending the completion and adoption of a national agreement with the shopmen's organizations.

SHOP EMPLOYEES TAKE NEW STRIKE VOTE

After ascertaining that this decision was final, the committee representing the shopmen, formally advised Mr. Hines on August 26 that they could not accept the offer, and an order was issued for a new strike vote. With the order were sent copies of the President's statement, at his urgent request, and also of Mr. Hines' proposition with the request that they be given most careful consideration at a summoned or called meeting of each craft. The letter to the officers and members of the unions calling for the vote stated that the director general had declared that the proposition was final and that there would be no wage increase granted to any other class of railroad employees as a class, but that in the event of unjust inequalities, as between individuals, adjustments involving increases to equalize rates of pay would be made where justified, except under the conditions stated in the fourth paragraph of the President's statement. The letter cautioned the men to consider their position

very carefully and not overlook the following important facts:

In any general wage increase which may be granted the shop crafts will receive the same consideration as other classes of employees.

If a strike is authorized the shopmen will be striking alone to force an increase for all of the 2,000,000 railway employees.

Owing to the large number of members involved, the international organizations will not be obligated to pay strike benefits beyond the limits of the funds available for that purpose.

FUNCTIONS OF THE WAGE BOARD NOW LIMITED TO ADJUSTMENTS

Director General Hines has addressed a letter to A. O. Wharton, chairman of the Board of Railroad Wages and Working Conditions, to define the functions which it is appropriate for it to perform in view of the decision announced by the President. For the present these are confined to the consideration of claims of any class or subdivision of a class of railroad employees to the effect that readjustments ought to be made in order to bring about equality of treatment on the basis of the general principles of wage adjustment which the Railroad Administration has already established. The board is expected to report a statement of facts, its conclusions upon the facts and its recommendations.

MODERN TENDENCIES IN ROUNDHOUSE DESIGN*

BY EXUM M. HAAS

Railroad Specialist, The Austin Company, Cleveland, Ohio

An engine terminal is a clearing house for motive power, hence anything done to obviate delays tends to increase the traffic-carrying capacity of the road without increasing the fixed charges. The tremendous increases in traffic, operating charges, and hauling capacity of locomotives and their cost have proportionately increased the demand for full utilization of a locomotive's earning power. Mere minutes saved on each locomotive handled, when multiplied by the total number of locomotives of a given road, and reduced to money, will finance unbelievable improvements.

I refer to this phase of the engine terminal problem to indicate that a road can afford to pay for the most efficient facilities. As a matter of fact, a 100-engine terminal can be built at present day prices, and fully equipped, for $660,000. This would result in annual fixed charges of about $69,300, at 10½ per cent for interest and depreciation, or at about $2 per engine per day. For a terminal of this size, a 20 to 25-stall roundhouse would be required. Assuming 24 stalls, the house would cost about $220,000, or about one-third of the terminal cost. This amount would provide a roundhouse, equipped with all the modern labor-saving facilities, and it could be sc constructed as to reduce depreciation to a minimum. For instance, a reinforced concrete structure would carry a rate of about 2½ per cent for depreciation, whereas a brick wall, wooden frame and roof structure would carry at least a rate of 5 per cent.

While the weight of locomotives has increased about 100 per cent, the cost has doubled. This also emphasizes the need for better facilities for the protection of the motive power. A locomotive is not a fire risk in itself, but when it is placed in a wooden roof roundhouse it certainly becomes one.

Some roundhouses are quite important running repair shops; hence anything incorporated in the design that will reduce the time to clear a locomotive should be adopted. Of course, there is an economical limit to the amount that can be spent, but that need not worry most of us, because there is so much room for improvement at most terminals that we would find it difficult to reach the limit of cost. For instance, engine terminal costs varied in 1918, so far as my knowledge goes, from $25,000 to $50,000 per stall of house capacity. The roundhouse proper has varied in cost from $6,000 per stall, with lighting, heating and plumbing, to $22,000 per stall. Both of these figures are high for the types of construction used, because of the abnormal labor and material market conditions prevailing in 1918, but the cost relation would hold even in normal times. On the other hand, from what I know of the labor-saving facilities provided in the higher-priced terminal and the permanence of its construction, I believe the mechanical department will have no difficulty in justifying the greater investment.

*Abstracted from a paper presented before the Western Society of Engineers, Chicago, May 12, 1919.

RELATION OF ROUNDHOUSE DESIGN TO LABOR

Another of the broader questions affecting roundhouse design at present is labor. This concerns the quantity and class of help available, and the working conditions and wages. Under prevailing industrial conditions intelligent labor has obtained employment at higher wages and with more satisfactory working conditions than are commonly found in and about a roundhouse. The roundhouse design must meet this form of competition or the quality of labor will fall below its present standard, and roundhouse labor is none too intelligent now.

Conditions in the average roundhouse built 20 years ago were not conducive to efficiency or economy. Poor day and night illumination and a lack of proper handling and machine tool equipment not only reduced the capacity of the house for clearing locomotives, but resulted in serious delays. On the other hand, the shortage of desirable help and the correspondingly higher prices that must be paid to obtain good men, make it important that all the facilities necessary and consistent with economy be provided to increase the production per man. The increased use of bridge and jib cranes in roundhouses is evidence of an appreciation of this fact. The substitution of the electric hoist for the truck and driver drop pits is another example. Improved daylighting in the working areas, and better heating and ventilation are also examples of the tendency to improve roundhouse conditions. Paved floors and walks, attention to good drainage, all add to engine terminal efficiency, and do not materially increase the fixed charges.

MODERN TYPES OF CONSTRUCTION

Modern roundhouses divide themselves into three classes—the brick wall, wood frame and roof; reinforced concrete frame and roof, and a combination of steel frame and reinforced concrete structure. In one or two instances, concrete frames with wooden roofs have been built to reduce first cost, and in others reinforced concrete unit construction was adopted. The brick wall, wooden frame and roof construction has been most generally used because of its cheapness.

A roundhouse located at an unimportant terminal, housing engines that are comparatively small, is usually of simple design. The present tendency, however, is to increase the height to improve daylighting and ventilation. Houses of this type should be built of slow burning construction throughout—nothing less than 2-in. sheathing, preferably 3-in., on 6 in. by 12 in. rafters and heavily coated with a fire-resisting paint.

On many roads the frequent post spacing has been found objectionable. This was the case with the New York Central Lines, and a 64-ft. truss has been substituted in the working area for the columns and beams. These trusses were formerly of heavy timber construction, but are now built up of bolted planks. The reason for this change was to cheapen the construction without reducing the quality of the lumber.

This house has a one-bay portal way, with a lean-to at the back of the house. The lean-to in the rear not only provides a working aisle, but also permits the locomotives to be shifted over the driver and truck drop pits. There is some difference of opinion regarding the advantages of the lean-to style of construction but it is undoubtedly a cheaper construction than if the trusses had been carried the full width of the house.

In but comparatively few instances have the reinforced concrete houses, which are now being quite generally used, followed the same section as the wooden frame roundhouses. Generally speaking, however, they have been of the monitor-type construction, varying principally in the number and spacing of the columns. For instance, Philadelphia & Reading has built a house of three-bay construction, two low bays on each side of a monitor section. The interior columns are all structural steel encased in concrete. The reason for adopting this type of column was to permit the installation of a jib crane. The roof is a combination floor tile, T-beam construction to form an insulating medium against temperature changes and condensation. All sashes are of steel with pivoted ventilating sections. As an aid in ventilation, five permanent slot openings were provided at the ceiling line between each set of columns in both sides of the monitor and through the back wall. In addition, of course, there is the smoke jack and the opening around it.

I believe the first instance where a bridge crane was installed in a roundhouse was that in one built by the Baldwin Locomotive Company at Philadelphia. This was built for repairing locomotives, and is equipped with two cranes, the larger of which is of 50 tons capacity. Among the first of the bridge crane types of houses built by a railroad was that of the Pennsylvania Railroad at Altoona, Pa. It was constructed in 1902 and consists of 52 stalls, handling an average of between 250 and 350 locomotives daily. The head room in the crane section is about 30 ft. and the crane capacity is 12½ tons. It is interesting to note that an analysis of roundhouse crane requirements on the Pennsylvania Railroad made recently developed the fact that the maximum load that a crane would be required to handle was about 8½ tons. This meant that a 10-ton crane would be adequate for all purposes.

Another house along similar lines, and one which has been described quite frequently in technical journals, and railroad engineers' hand-books is that of the Western Maryland at Hagerstown, Md. This house is a steel frame construction, encased in concrete. Woven wire mesh was wrapped about the steel, and the concrete put in place by the Gunite system. The roof slab is 3-in. concrete with Hyrib reinforcing. It is of double monitor construction, permitting daylight to enter at three points in addition to the back wall. In connection with steel frame houses, I would call your attention to the fact that built-up columns, girders of heavy section, are being used as the frame in the new houses recently built by the Pittsburgh & Lake Erie. This company believes that if proper attention is given to the painting of these steel frames an unusually long life may be obtained from them.

The type of house recommended where repairs are light has a reinforced concrete frame with a column spacing that results in economical concrete beam construction. The roof slab is flat on the under side, and is formed with 8 in. by 24 in. floor tile, and 4 in. concrete T-beams. This provides an insulated roof and one which is just as cheap to construct as the plain slab. The location of the monitor windows is such that it will throw daylight into the working area. In addition, the sash area in the lean-to at the back of the house is large. Provision has been made for omitting one set of columns in the drop pit section. This is done to provide a clear floor area between the pits for removing wheels from the drop pits to the back of the house. Permanent openings 4 in. by 18 in. in section at the front and rear of the monitor and just below the roof slab will take off the gases which collect at those points.

So far as we can learn, the life of steel sash in a roundhouse is somewhat longer than of wooden sash in the same location, and it is just about as cheap. If it is kept well painted, steel sash has the additional advantage of not swelling under excessive moisture, and therefore the ventilators can be just as readily operated in the winter months as in the summer.

In houses where heavy repairs are made a crane of approximately 50 ft. span should be provided which, with a slight shifting of the locomotive, will reach any of the heavy repair parts which have to be handled. The height of the crane rail should be 26 ft. 6 in. above the floor line, which is sufficient to permit of the crane removing the cab without striking other parts of the locomotive. This height also greatly facilitates all crane movements. In a house with a craneway the objection may be raised that the crane installation does not permit the installation of the usual smoke jack. It has been found in houses of this section that the high monitor and the installation of a large ventilator or jack in the roof over each stall does not result in an objectionable accumulation of gases and smoke. In the winter time, and even in the summer, the fan in the hot blast heating system can be kept running to force out the gases.

I also want to call attention to the growing tendency to substitute the electric hoist for the truck and driver drop pit. In addition to reducing liability of accidents it removes wheels more quickly and cheaply. While this hoist is sometimes installed in the roundhouse, its proper location is in the back shop.

Serious objection to the drop pit has developed in recent years, owing to the extremely heavy locomotives and to the declining quality of roundhouse help. While accidents due to jacking up the locomotives for the removal of wheels do not occur frequently, there is always the liability, and it has greatly increased because of the failure to obtain intelligent labor.

Two types of roundhouse doors are quite generally used—a two-leaf steel-frame, wooden swinging door, and a rolling wood slat door. The former is the most popular because repairs are more readily made. The question is frequently raised whether or not it is desirable to provide sash in the door or in a transom over the door. Sash in the door permits lowering the roof level, but to some it is objectionable because the rough usage results in frequently broken glass. Daylight at the front of the house is not so essential, and all that is really needed may be had through small transom sash. On the other hand, it has been found that most of the blows which would break the glass in the door would break a wooden panel, and the glass is more readily replaced than the wood. For that reason, the glass area in the doors is made quite liberal in the roundhouses built by a number of roads.

Another tendency in roundhouse design and construction which has come into more general use in the past few years is the substitution of the hot blast heating system for the pipe coils or other forms of direct radiation. A hot blast heating system installation costs very little more than a direct system, and it has the additional advantage of providing forced ventilation in the house, which is often very necessary. At first the selection of too low fan and radiation capacity resulted in the indirect system being unsatisfactory. This has been corrected, and the fan may be speeded up in extremely cold weather to raise the temperature for thawing out frozen locomotives quickly.

TYPES OF VALVE GEAR ON FRENCH LOCOMOTIVES

BY W. G. LANDON

Various complicated arrangements of the Walschaert valve gear, all of which are in regular use on many French locomotives, are shown in the sketches. They are a further illustration of the difference between the French and American points of view and consequently the difficulty of making American equipment popular in France.

Fig. 1 shows a gear fitted to a large number of 4-4-0

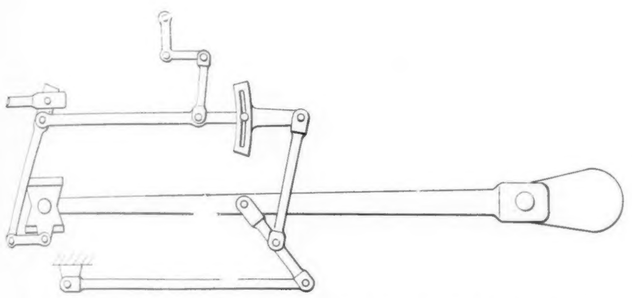


Fig. 1—Valve Gear as Applied to Etat 4-4-0 Type

engines built over twenty years ago for the Ouest (now Etat). It will be seen that a projecting arm from the link is actuated by a portion of the Joy gear. This gives a rapid valve travel at the beginning of the stroke, and the valve movement is perhaps more nearly theoretically correct

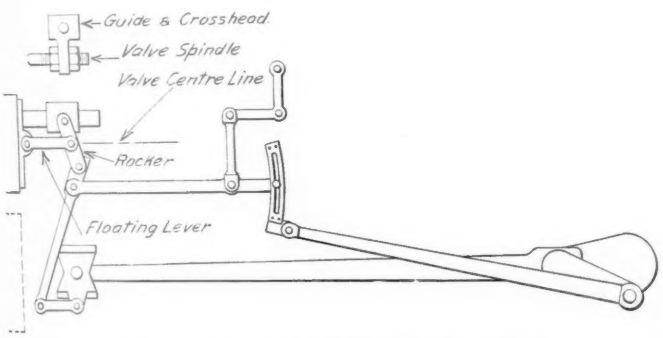


Fig. 2—Valve Gear as Applied to Etat 4-6-0 Type

than if the link were actuated by an eccentric. It would seem, however, that there are the disadvantages of the Joy gear (distortion from vertical movement of axle) plus a lot of extra parts. The driving wheels on this class of engine

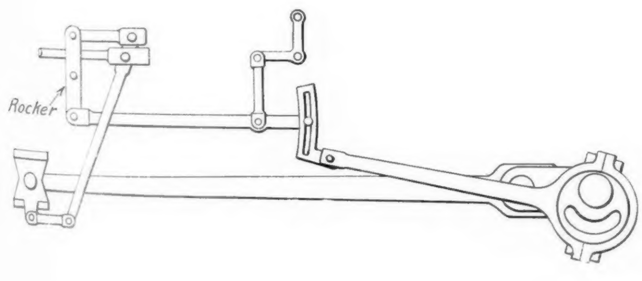


Fig. 3—Valve Gear as Applied to P. L. M. 4-6-0 Type

are equalized, but no trouble is experienced by valves getting out of square once they have been set for normal axle position.

Fig. 2 shows the evils of standardization. When a 4-6-0 superheater class engine was brought out on the Etat, the valve gear was made standard with that on the saturated engines, which have outside admission valves. The superheater engines have inside admission valves so a rocker arm was put in to make the gear distribute properly for inside admission. It will be seen that the thrust from the rocker is not in line with the valve center, and it is difficult to see anything but disadvantages either from a theoretical or practical standpoint. This arrangement is also used on the Nord.

Fig. 3 shows the valve gear on l.p. (inside) cylinders of

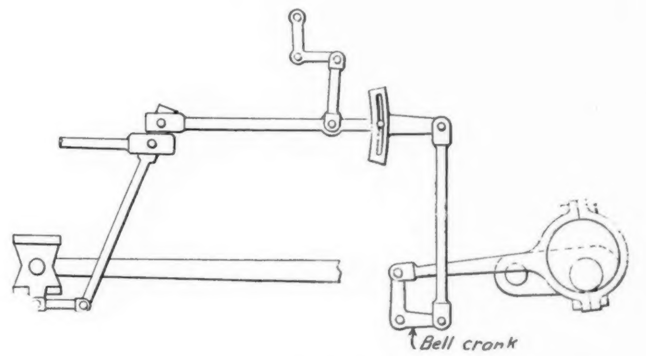


Fig. 4—Valve Gear as Applied to P. L. M. 4-8-0 Type

4-6-0 class on the Paris, Lyons & Meriterranean. The reason for the arrangement apparently was the fact that the links would not clear the bottom of the boiler. Other and simpler solutions of the problem would not, however, be hard to find.

Fig. 4 shows the gear on l.p. (inside) cylinders on 4-8-0 class, Paris, Lyons & Mediterranean. The object of this detour from eccentric to link the writer could not fathom.

PULVERIZED FUEL

At the annual convention of the International Railway Fuel Association held in Chicago, May 19-22, 1919, the Committee on Pulverized Fuel presented a progress report which consisted of the summary of some of the results obtained with pulverized coal with comments and suggestions. An abstract of the report follows:

Results obtained from tests brought out the following points: (a) A saving of 23 per cent in fuel could be made by burning pulverized coal. The main difficulties were the slagging over of the flue sheet and burning out of the brick arch. The slagging was largely overcome by an air jet to blow off the slag accumulations, but it was found impossible to overcome the rapid burning out of the brick arch. The cost of replacing the arch brick largely overcame the saving in fuel. The delay to locomotive was also a decided drawback.

"A comparison of costs of hand firing versus pulverized coal showed the hand firing to be most economical. It is thought possible to design a firebox that will eliminate such troubles as burning out of the brick arch and show an advantage in favor of the pulverized coal."

(b) "Burning 60 per cent anthracite and 40 per cent bituminous pulverized fuel gave all the steam that was wanted with splendid ocntrol.

(c) "The burning of pulverized coal in a locomotive was quite easy and satisfactory. The difficulties were with drying, pulverizing and handling the coal, and also the danger in connection with it. Locomotives equipped to burn pulverized coal would be tied up were the pulverizing plant to be burned or otherwise made inoperative."

One foreign railroad, the "Central Railway of Bra-

zil," has made marked progress in burning pulverized coal. (See *Railway Age*, Oct. 26, 1917, page 767.)

Many pulverized fuel installations in stationary plants are reported as successfully burning various coals in pulverized form. A southwestern railroad reports: "Our stationary boiler plant that used pulverized fuel has been compelled to use a considerable amount of oil on acocunt of breakdowns and other troubles. We have had very little service on two boilers because of overhauling and remodeling of the fuel equipment. We kept the plant going on pulverized coal most of the time, but it has been a forced proposition."

The following conclusions may be deduced: The art of burning pulverized coal has shown marked progress; the experimental work has demonstrated the soundness of the principle of burning coal in a finely divided form in suspension, and that complete commercial success depends upon the careful working out of such details as proper fineness of the various grades of coals and economical and efficient methods and apparatus for preparing, storing and transporting the pulverized coal to the stationary plant or locomotive furnace. The tendency of explosion and spontaneous combustion should be eliminated entirely if possible to do so. The reabsorption of moisture will always be a problem in climates having extreme variations of temperature and humidity. It seems advisable to give more careful consideration to the steam locomotive as it exists today. A pulverizing and stoking device might be arranged that would prepare any grade of coal on the tender and deliver it to the firebox in the pulverized form, thus eliminating the expense of repairing and transporting pulverized coal from a central plant. Many of the universities have very thoroughly equipped laboratories that we are not using to a sufficient extent. It is suggested that in view of the immense supply of bituminous, lignite and other grades of coals adapted to the pulverized method of burning, the railroads, with the assistance of manufacturers and universities, make conclusive and exhaustive tests to develop the methods and apparatus necessary to meet the very urgent demands for more economical burning of coal.

The report was signed by W. J. Bohan (N. P.), chairman; H. T. Bentley (C. & N. W.), H. B. Brown (L. V.), R. R. Hibben (M., K. & T.), D. R. MacBain (N. Y. C.), J. H. Manning (D. & H.), H. C. Oviatt (N. Y., N. H. & H.), John Purcell (A., T. & S. F.), and L. R. Pyle (U. S. R. A.).

DISCUSSION

J. E. Muhlfeld (Pulverized Fuel Equipment Corporation) in a written discussion took issue with some of the statements in the committee's report. He asserted that the practicability of burning powdered coal had been established, and that it was necessary to develop it in order to increase the efficiency and capacity of the locomotive, to decrease the cost of fuel, to permit of using coal of poor quality and to eliminate smoke and soot. A. G. Kinyon (Fuller Engineering Company) submitted records of installations and reports of tests showing the high efficiency of boilers fired in this manner. Several speakers called attention to the fact that troubles similar to those experienced with pulverized fuel had been encountered in the period of development of practically all the accessories used on locomotives. M. C. M. Hatch (Pulverized Fuel Equipment Corporation) expressed the opinion that the crux of the matter lay in the design of a locomotive furnace. Large furnace volume is needed for burning pulverized fuel and no locomotive has yet been built with the proper design of furnace for this fuel. Where proper care is taken in designing the furnace, stationary installations are uniformly successful.

The association decided to ask the co-operation of Purdue University, the University of Illinois and the Bureau of Mines to solve the problem of burning pulverized coal.

LOCOMOTIVE FUEL LOSSES AT TERMINALS*

BY J. M. NICHOLSON
Fuel Supervisor, Atchison, Topeka & Santa Fe

The fuel consumed by locomotives while in terminals is an incident of operation which requires a variable amount of fuel and has been given too little consideration for the quantity involved. The engineer and fireman, who are with the locomotive while from 75 to 90 per cent of the fuel is burned, have been charged with being very wasteful. The remaining 10 to 25 per cent is burned at the terminal in getting the locomotive ready for service and taking it to the enginehouse, much of which is the result of wasteful methods and practices.

Locomotives must be moved from yards to cinder pits, have the fires knocked, and be put in the house in order that necessary repairs can be made. They must be fired up and tests of locomotive auxiliary appliances properly made, after which they must be moved from the roundhouse to the train. These essential activities of operation require the use of fuel, but the fuel used in addition to that required for these purposes must be considered as waste.

When a locomotive is brought to a terminal the fire should be burned down to such a point that it will not be necessary to rebuild the fire in order to get the water level in the boiler to the proper height before knocking the fire. The dampers on oil burning locomotives and also coal burning locomotives, so equipped, should be closed as soon as the work at the cinder pit is completed and the blower shut off to reduce circulation of air through the boiler.

The roundhouse capacity should be such that no delay will be caused in getting the locomotive into the house. When a locomotive reaches the house a competent inspector should enter the firebox and see that the flues are clean and free from leaks. The arches must be clean and in repair. The grates must be thoroughly cleaned, and grates having broken fingers or excessive openings repaired or removed. The ash pans must be thoroughly cleaned and special attention given to see that the air opening under the mudring is cleaned. The front end should be inspected to see that it is self-cleaning and that it is free from air leaks.

As soon as the boiler and grate work is completed the grates should be bedded down with from three to four inches of coal evenly distributed over the entire grate area. The coal which falls through while bedding down the grates should be reclaimed. Tests show the coal reclaimed will vary from 80 to 200 lb. per locomotive, depending on the size of coal used and the amount of surface moisture on the coal. The coal can be reclaimed by collecting it in a bag fastened to the ash pan slide and removing the bag as soon as the grates are bedded down, or at larger terminals a pit on the outgoing track can be used for dumping this coal and conveying it into the car. A terminal handling 50 locomotives per day will conserve from 50 to 100 tons per month by reclaiming this coal.

In case the boiler is to be washed, the heat in the boiler is entirely wasted unless the roundhouse is equipped with a hot water boiler wash-out system. A plant of sufficient capacity, if properly maintained and operated, will reduce the time consumed in the operations of washing the boiler from 25 to 50 per cent and reduce the amount of fuel used in firing up from 25 to 30 per cent. The saving of from two to three hours' time in getting the locomotive back in service

*Abstract of a paper presented before the International Railway Fuel Association convention at Chicago, May 19-22, 1919.

is an important factor under present operating conditions, as is also the saving of from 600 to 700 lb. of coal per locomotive.

In many cases where boilers are not due to be washed out engines are allowed to stand in the roundhouse twelve to fifteen hours before the time set for the locomotive to leave the roundhouse. During this time the heat in the boiler has been passed out through the stack unless a stack cover is used or the dampers closed to prevent circulation of air through the boiler. This heat waste can be found in practically every roundhouse, and results in several tons of coal per locomotive being wasted each month. The time required to furnish a locomotive is greatly influenced by the pressure maintained in the roundhouse blower steam line. Insufficient pressure results in the use of more coal in firing up a locomotive and decreases operating efficiency. The use of old ties, old car material, shavings, etc., will reduce the amount of coal consumed and should be used where practical.

The chief despatcher should furnish the roundhouse foreman with a list of trains that he expects to run and the roundhouse foreman should furnish the despatcher with a list of locomotives he expects to have ready. The exchange of these lists three times in twenty-four hours is advisable, after which the locomotives should be ordered for a scheduled leaving time, giving the roundhouse the necessary time to fire up the locomotive and call the engine crew. This will avoid holding locomotives under steam in cases where trains are set back or cannot be run according to the line-up. In cases where locomotives are fired up as soon as the work is completed and allowed to stand under steam for seven hours, the fuel wasted is equal to the amount of fuel that is necessary to furnish the locomotive for service. This is not an uncommon occurrence where despatching schedules are not in effect and where they are not given close supervision.

The wages paid for one hour's terminal delay on a freight train is a loss equivalent to the cost of one ton of coal, also eight locomotive hours under steam in addition to the time actually necessary to get the locomotive ready for service is a loss equal to the value of a ton of coal. Every locomotive on a division is burning some fuel at the terminals that is unnecessary, and many locomotives are burning before each trip fuel of greater value than the loss of wages paid for one hour's terminal delay. If this loss were given as close supervision as is given the wages paid for terminal delay, the cost of transportation would be reduced. Superintendents should know personally that locomotives are not being held under steam unnecessarily on their division and also that co-operation in the despatching of locomotives does exist.

The fuel that is consumed as a result of lack of facilities for handling is a costly proposition, and adequate roundhouse and shop facilities should be provided. Repairs to turntables, roundhouses, coal chutes and tracks at the terminal should be made before cold weather sets in, as it may result in congested single track movement at coal chutes and cinder pits or tie up the entire roundhouse, all of which wastes fuel. Proper care of a fire in the roundhouse contributes to economic locomotive performance on the road and also reduces the amount of fuel used at the terminal. The locomotive appliances should be tested out before leaving the roundhouse for the train to see that they are in the best possible condition to do their work, which means a saving of fuel on the road that, in most cases, cannot be accomplished after leaving the terminal. The train line leakage should be determined and the leaks repaired at the terminal. Train line air leaks cost a railroad company much more than it costs to repair them.

Locomotives should be maintained to prevent serious steam, air and water leaks. Throttles leaking, pops leaking and air pumps running in the house are to be avoided. All of the operations at a roundhouse contribute to fuel economy, and men should be impressed with the fact that neglect on their part often results in a waste of fuel greater than their day's wages before the locomotive reaches the next terminal where proper repairs can be made.

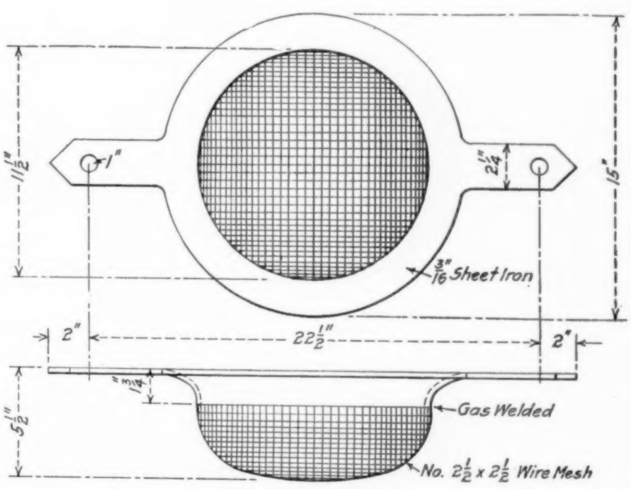
The amount of coal required for the period of firing up a locomotive and getting it ready for service under careful handling should be determined. The actual consumption against the required consumption is the fuel efficiency of the despatchers and the roundhouse organization. This efficiency is not a maximum, even on the best managed and best equipped roads. The magnitude of the amount of fuel involved in these losses should provide a strong incentive to renewed effort in fuel conservation as these conditions of fuel waste are decreasing operating efficiency and increasing the cost of transportation.

A LOCOMOTIVE SAND BOX SCREEN

BY A. P. JANDER
General Foreman, A. T. & S. F., Hutchinson, Kans.

A source of great annoyance in the roundhouse and on the road is the stoppage of the pipes and traps of the locomotive sanding apparatus. A properly working sanding apparatus is especially to be desired in bad weather as great harm is often done to an engine through the failure of the sanding equipment to work properly at a critical time, and in addition the delays occasioned by the failure of this apparatus frequently have serious results.

In drying and screening sand at the sand house all foreign matter is not always removed and this getting into the sand box eventually chokes the sand pipe so that the apparatus will not operate in a satisfactory manner. To overcome this trouble the writer has designed a sand box screen as illus-



Screen for Use in Filling Locomotive Sand Boxes

trated in the accompanying sketch. This screen may be adjusted over the mouth of the sand box and as the sand is poured in, the screen is turned slightly, thus permitting the clean, fine sand to enter the box, but excluding all stones and foreign matter. Two of these screens kept in a convenient place, one on each side of the sandhouse, so that they may be used when filling the sand boxes of locomotives, will eliminate a great deal of the trouble experienced on the road. The expense of making the screens and the time required for their operation is so small that it need not be considered. An engine can be as easily and as quickly sanded with these screens as without them and if made of proper material, they are practically indestructible.

RAILROAD ADMINISTRATION NEWS

Enlargement of the Board of Railroad Wages and Working Conditions from six to twelve members is under consideration. Such an enlargement has been proposed by the labor board. It is proposed to add a representative of the engineers, clerks and maintenance of way employees and three more officials.

A NATIONAL "DRIVE" FOR SAFETY

Walker D. Hines, director general of railroads, announces that a "National Railroad Accident Prevention Drive" will be started on October 18 at 12:01 a. m. and will be continued until October 31 at midnight, to be conducted under the supervision of the Safety Section. A circular, sent to the regional directors, calls for their co-operation. All officers and employees are expected to give their hearty support.

This drive follows the very satisfactory results of certain "no accident campaigns" already carried out. The results of these campaigns are summarized as follows:

Region	Total No. of employees	Casualties, 1919	Casualties, 1918
Southern, January 19-25	230,000	77	466
Southwestern, May 1-31	174,884	646	1,475
Central Western, June 22-29	327,000	100	456
Northwestern June 22-29	274,234	119	481

In the Southern region 28 out of 45 railroads reported no accidents; in the Southwestern region 12 roads were in this class, in the Central Western 47 out of 67 and in the Northwestern 50 out of 63, showed clear records.

FIREMEN DEMAND MECHANICAL STOKERS AND WAGE INCREASE

In order to meet the high cost of living the Brotherhood of Locomotive Firemen and Enginemen has decided that its members must have not only a large increase in wages, estimated at 35 to 65 per cent, but also the assistance of mechanical stokers on engines weighing over 200,000 lb., mechanical coal passers on locomotives of less weight, and power grate shakers and fire door openers on all locomotives.

The demands are as follows: Firemen and helpers in passenger service, $6.50 a day of 5 hours or less, 100 miles or less (Mallet locomotives, $7.20); through freight service on locomotives weighing less than 200,000 lb., $6.50 a day for 8 hours or less, 100 miles or less, on locomotives weighing over 200,000 lb., $6.80; local or way freight service, mixed trains, mine runs, etc., minimum of 50 cents per 100 miles or less in addition to through freight rates; helper, pusher, transfer, work, wreck, construction, snow plow, circus, milk and unclassified service, through freight rates; yard service, $6.50 (Mallet $6.80), on Mallet locomotives in all except yard service, $7.20 a day; inside hostlers, $6.80 a day; outside hostlers, $7.20; hostler's helpers, $6.50, eight hours or less; all coal burning locomotives to be equipped with power grate shakers and automatic fire door openers. All coal-burning locomotives in road service weighing over 200,000 lb., to be equipped with mechanical stokers and two firemen to be employed on each engine until so equipped. All locomotives weighing less than 200,000 lb. to be equipped with coal passers. Firemen to be relieved of cleaning locomotives, removing tools or supplies, loading coal, filling lubricators, etc.

ROADS CO-OPERATE WITH VOCATIONAL EDUCATION BOARD

W. T. Tyler, director of the Division of Operation, and W. S. Carter, director of the Division of Labor, have issued the following joint circular authorizing co-operation by the railroads in the establishment of part-time schools for railroad apprentices and others:

"The Federal Government has created under the provisions of an act of Congress, approved February 23, 1917, a Federal Board for Vocational Education.

"The purpose of this act is to provide for the promotion of vocational education in the trades and industries and in agriculture in co-operation with the various states, and an appropriation by the Federal Government is available for such work.

"The value of vocational training for mechanics and apprentices in railroad shops has been recognized by many railroads which have established schools for the training of such men. It is the desire of the Railroad Administration not only to assist and encourage such training where established, but also to extend the system to roads which have not established such schools, and it is believed that this can be best accomplished by co-operation between the United States Railroad Administration and the Federal Board for Vocational Education in extending this work.

"It is therefore desired that the different railroads under control of the United States Railroad Administration co-operate with the Federal Board for Vocational Education in the establishment of part-time schools for railroad shop apprentices and others who come within the scope of the act. Where it is found necessary in order to facilitate this work, railroads will be authorized on request, to fit up suitable study or class rooms at the different shops where such schools may be held. Where such schools are established, railroads will be authorized to pay apprentices at their usual rate for the time spent in attending such schools.

"Apprentices on roads where such schools are established will be required to attend not less than 208 hours per year.

"Complete information concerning the establishment of these schools in co-operation with the Federal Board for Vocational Education may be obtained either from the board direct or from the assistant director, Division of Operation, in charge of the Mechanical Department.

"In the preparation of a course of study, due attention must be given to meet the needs of railway shop employees, and such subjects as shop practice involving the manipulation of machines used in general repair and construction work and to related science, mathematics and drawings should be fully provided for.

"To provide uniformity as far as practicable in these courses of study, the subjects embraced therein should be submitted to the assistant director, Division of Operation, in charge of the Mechanical Department, for approval."

ORDERS OF REGIONAL DIRECTORS

Safety Chains on End Doors.—Order 227 of the Southwestern regional director promulgates a note from the Safety Section of the Railroad Administration recommending that chains or some other suitable device be applied on automobile cars with end doors to prevent these doors from opening further outward than the line of the side of the car; and gives instructions to have cars in this region so equipped as rapidly as possible.

Freight Car Distribution—Circular 27.—The Southwestern regional director in Circular 234 states that the provisions of Division of Operation Circular 27 with respect to returning cars to owners for repairs appear to have been more broadly construed than was intended. Cars have been sent long distances home for comparatively light repairs. The purpose of this circular was to put into effect former M. C. B. requirements for the return of cars to owning lines for repairs and in addition the circular was intended to provide a means for the owners to get their cars home when desired for rebuilding or for the application of betterments. It was not desired that the cars should be sent home involving an intermediate line haul except for "rebuilding or for the application of betterments" as provided in paragraph *C* of the circular, in which case arrangements should be made for this movement in accordance with paragraph 6.

CAR DEPARTMENT

STEAM HOSE FOR CAR HEATING*

BY H. J. FORCE

The object of this paper is to describe briefly a process of manufacture of steam hose for car heating which will neither contract nor expand when in service.

When made from duck alone, steam hose has been found to contract to such an extent in service that in some cases it becomes uncoupled when passing around a short curve. Again, the failure of steam hose in many cases has been traced directly to the excessive expansion which takes place after the hose has been in service for some time. This expansion frequently results in the hose blowing off from the coupling, requiring the use of a special clamp to hold the hose on the coupling.

After making a series of tests, it was decided to build a hose of duck with a heavy friction, and then one or more layers of braiding. If made from duck alone, hose will expand excessively. It is impracticable to make it from braiding alone, but with a combination of duck and braiding a very satisfactory grade of steam hose can be produced which will show no contraction in length and no expansion in diameter under the most severe service conditions.

Table I gives a general description of the process of manufacture of four hose designated as Serials P, Q, R and S.

In Table II are given results of tests to destruction of two samples of steam hose of Serial P. In this hose a special steam-resisting compound was used for the inner tube which was not looked upon favorably by the manufacturer.

In Table III are given the results of tests on ten samples of hose of Serial Q. This hose is similar to that of Serial P except that the regular specification tube was used which had been found to give fairly satisfactory results in service. Aside from this Serials P and Q are of the same composition. The samples of Serial Q, after steaming, withstood a pressure of 60 lb. for about 700 hours, on the average, before bursting.

In the hose of Serial R, the manufacturer endeavored to

TABLE I—DESCRIPTION OF MANUFACTURE OF FOUR KINDS OF STEAM HOSE

Serial	Tube	Thickness, in.	Duck	Friction	First ply of gum to anchor braiding	First ply braiding	Second ply of gum to anchor braiding	Second ply braiding	Outside cover
P......	Special steam resisting hose.	1/8	2 ply, not under 23 oz. per sq. yd.	Heavy coated special steam resisting.	1/16 in. thick, special steam resisting.	No. 8/3 yarn in 5 by 5 strands.	1/32 in. thick, special steam resisting.	No. 8/3 yarn in 5 by 5 strands.	1/32 in. special steam resisting.
Q......	Regular specification steam hose.	1/8	Same as P.	Heavy coated regular specification steam resisting.	1/16 in. thick, regular specification steam resisting.	Same as P.	1/32 in. thick, regular specification steam resisting.	Same as P.	1/32 in. regular specification steam resisting.
R......	Regular specification steam hose.	5/32	Same as P.	Same as Q.	Same as Q.	Same as P.	Same as Q.	Same as P.	Same as Q.
S......	Regular specification steam hose.	5/32	3 ply, not under 23 oz. per sq. yd.	Same as Q.	Same as Q.	Same as P.	Same as Q.	Same as P.	Same as Q.

TABLE II—TESTS OF HOSE, SERIAL P

All Hose Steamed to Bursting 10 Hours a Day at 60 Lb. Pressure

Sample No.		1	2
Inside diameter, in.	Before steaming..	1.625	...
	After steaming...	1.75	1.69
Outside diameter, in.	Before steaming..	2.625	...
	After steaming...	2.75	2.69
Thickness, in.	Before steaming..	0.125	...
	After steaming...	0.213	0.230
Number of plies		2	2
Friction, in.	Before steaming..	4.125	...
	After steaming...	3.0	4.0
Stretch of cover, in.	Before steaming..	7.5	...
	After steaming...	5.0	5.5
Stretch of tube, in.	Before steaming..	8.5	...
	After steaming...	5.0	5.0
Deflection, in.	Before steaming..	2	2.0
	After steaming...	2.75	1.25
Tensile strength of tube, lb. per sq. in.	Before steaming..	600	...
	After steaming...	70	65
Time required to burst under 60 lb., hours	Before steaming..	...	...
	After steaming...	525	840

*A paper presented before the convention of the American Society for Testing Materials at Atlantic City, June 24-27, 1919.

TABLE III—TESTS OF HOSE, SERIAL Q

All Hose Steamed to Bursting 10 Hours a Day at 60-lb. Pressure

Sample No.		1	2	3	4	5	6	7	8	9	10
Inside diameter, in.	Before steaming...	1.625	....	....	....	....	....	....	....	....	....
	After steaming....	1.72	1.69	1.69	1.69	1.562	1.69	1.69	1.75	1.625	1.75
Outside diameter, in.	Before steaming...	2.5	....	....	....	....	....	....	....	....	....
	After steaming....	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Thickness, in.	Before steaming...	0.125	....	....	....	....	....	....	....	....	....
	After steaming....	0.113	0.160	0.160	0.167	0.169	0.155	0.16	0.163	0.170	0.171
Number of plies		2	2	2	2	2	2	2	2	2	2
Friction, in.	Before steaming...	0.25	....	....	....	....	....	....	....	....	....
	After steaming....	1.5	7.0	4.0	1.5	1.25	6.0	8.0	6.0	3.0	4.0
Stretch of cover, in.	Before steaming...	7.25	....	....	....	....	....	....	....	....	....
	After steaming....	2.5	4.0	3.5	4.0	3.0	3.0	3.0	4.0	3.0	3.5
Stretch of tube, in.	Before steaming...	7.0	....	....	....	....	....	....	....	....	....
	After steaming....	5.75	3.5	3.0	5.0	6.0	3.0	3.5	4.0	3.5	3.5
Deflection, in.	Before steaming...	3.0	2.75	2.75	2.875	2.875	2.5	2.75	2.5	2.5	2.625
	After steaming....	2.0	2.0	1.75	2.0	1.25	1.25	1.375	2.0	1.75	2.0
Tensile strength of tube, lb. per sq. in.	Before steaming...	570	....	....	....	....	....	....	....	....	....
	After steaming....	336	118	125	113	106	111	106	110	111	119
Time required to burst under 60 lb., hours.	Before steaming...	615	....	....	....	....	....	....	....	....	....
	After steaming....	60*	555	690	700*	700*	775	785	753	693	693

*Test samples removed before bursting.

increase the thickness of the inner tube. Results of tests of this hose are given in Table IV. In some of the lengths of hose tested after steaming, there was an apparent increase in thickness over that of the measured sample, as compared with Serials P and Q, although these too vary considerably showing that the tubes in many cases were undoubtedly not uniform in thickness, at least at various places in the tube. The results of tests on steaming were practically the same as those in Serials P and Q.

In the hose of Serial S the number of plies of duck was

TABLE IV—TESTS OF HOSE, SERIAL R

All Hose Steamed to Bursting 10 Hours a Day at 60-lb. Pressure

Sample No.		1	2	3	4	5	6	7	8	9	10
Inside diameter, in.	Before steaming	1.625	....	....	....	....	....	....	....	....	....
	After steaming	1.72	1.69	1.75	1.812	1.69	1.75	1.625	1.75	1.75	1.75
Outside diameter, in.	Before steaming	2.50	....	....	....	....	....	....	....	....	....
	After steaming	2.53	2.562	2.50	2.562	2.50	2.50	2.562	2.50	2.50	2.50
Thickness, in.	Before steaming	0.125	....	....	....	....	....	....	....	....	....
	After steaming	0.134	0.154	0.151	0.153	0.165	0.170	0.180	0.168	0.200	0.175
Number of plies		2	2	2	2	2	2	2	2	2	2
Friction, in.	Before steaming	0.625	....	....	....	....	....	....	....	....	....
	After steaming	0.625	1.75	4.0	7.0	1.875	4.0	6.0	4.0	7.0	7.0
Stretch of cover, in.	Before steaming	7.75	....	....	....	....	....	....	....	....	....
	After steaming	3.5	3.0	4.0	6.0	4.0	4.0	3.0	3.0	4.0	6.0
Stretch of tube, in.	Before steaming	5.5	....	....	....	....	....	....	....	....	....
	After steaming	5.5	4.75	3.50	4.0	5.125	4.0	4.0	4.5	4.0	3.0
Deflection, in.	Before steaming	2.0	2.625	2.75	2.125	2.75	2.25	3.0	2.75	2.375	2.875
	After steaming	2.25	1.50	1.50	2.0	2.0	1.25	1.0	2.50	1.50	1.875
Tensile strength of tube, lb. per sq. in.	Before steaming	511	....	....	....	....	....	....	....	....	....
	After steaming	313	137	130	124	115	106	94	143	90	114
Time required to burst under 60 lb., hours.	Before steaming	700	....	....	....	....	....	....	....	....	....
	After steaming	60*	700*	519	530	700*	625	754	680	793	525

*Test samples removed before bursting.

increased from two to three, and this apparently had the effect of nearly doubling the life of the hose. It will be noted from Table V that samples Nos. 5 and 6 of this hose burst under 60 lb. pressure, after steaming, in 770 and 800 hours respectively, and that samples Nos. 8 and 10 withstood this pressure about the same number of hours; while samples Nos. 4 and 9 stood up for approximately 1500 hours. A careful investigation of the inner tube revealed the fact that several of these samples were defective. Pieces of wood were found embedded in the inner tube which measured 1/4 in. wide, 1/8 in. thick by 1/2 in. long. The addition of this foreign matter to the rubber compound without a question of doubt caused the failure of samples Nos. 5, 6, 8 and 10, and this is primarily due to the use of machine-made tubes.

TABLE V—TESTS OF HOSE, SERIAL S

All Hose Steamed to Bursting 10 Hours a Day at 60-lb. Pressure

Sample No.		1	2	3	4	5	6	7	8	9	10
Inside diameter, in.	Before steaming	1.625	....	....	....	....	....	....	....	....	....
	After steaming	1.72	1.562	1.625	1.69	1.75	1.625	....	1.562	1.562	1.69
Outside diameter, in.	Before steaming	2.625	....	....	....	....	....	....	....	....	....
	After steaming	2.69	2.625	2.625	2.69	2.625	2.625	....	2.69	2.69	2.625
Thickness, in.	Before steaming	0.125	....	....	....	....	....	....	....	....	....
	After steaming	0.129	0.160	0.167	0.200	0.200	0.192	....	0.195	0.195	0.156
Number of plies		3	3	3	3	3	3	3	3	3	3
Friction, in.	Before steaming	1.0	....	....	....	....	....	....	....	....	....
	After steaming	2.75	6.25	8.0	8.0	7.0	2.0	....	2.5	8.0	3.0
Stretch of cover, in.	Before steaming	7.25	....	....	....	....	....	....	....	....	....
	After steaming	4.0	3.0	6.0	3.5	3.0	5.0	....	2.5	3.5	3.0
Stretch of tube, in.	Before steaming	5.25	....	....	....	....	....	....	....	....	....
	After steaming	5.0	4.5	6.0	3.0	4.0	4.0	....	4.0	3.5	4.0
Deflection, in.	Before steaming	2.50	2.0	2.0	2.5	1.75	1.75	2.0	1.625	1.75	1.50
	After steaming	1.25	1.50	1.0	1.25	0.75	0.875	....	0.625	1.0	1.0
Tensile strength of tube, lb. per sq. in.	Before steaming	520	....	....	....	....	....	....	....	....	....
	After steaming	325	125	132	80	105	94	....	103	177	141
Time required to burst under 60 lb., hours.	Before steaming	700	....	....	....	....	....	....	....	....	....
	After steaming	60*	700*	700*	1477	770	800	....	830	1535	862

*Test samples removed before bursting.

It is recommended that in all steam hose or in any hose that is subjected to considerable temperature, a calendered-made tube composed of three distinct layers should be used. This will very materially reduce the chances of dirt or foreign matter getting mixed with the rubber compound, and should a small amount be present the other two calenders will undoubtedly preserve the life of the hose.

This investigation shows:

1. That steam hose should be made of a composition of duck and braid.

2. That machine-made tubes should not be used, and that tubing of three-ply calender should in every case be used in hose which is to be subjected to any considerable degree of temperature.

COLOR OF LOCOMOTIVES.—"Speaking of Chinese railroads reminds me of the failure of an American manufacturer to obtain a contract for locomotives because his European competitors made a more careful study of Chinese peculiarities," writes Lynn W. Meekins in the Scientific American. "One locomotive was ordered from each of the competing companies. In every respect save one the American product was unmistakably superior. However, it had been painted black before shipment from the works, and on the way across the Pacific it became more or less rusted. Its appearance, therefore, was far less attractive than that of the European locomotives, which were painted in accordance with Chinese preference, and had been touched up by the manufacturers' agents after arriving in China. Don't get your colors mixed if you want to sell goods to the Chinese."

PRICES AND PRODUCTION.—"Far more wealth is probably lost through restricted output than is claimed in increased wages," say the Times, London. "It is not certain at present how far the industries concerned can pay the advances of wages that are or will shortly be asked, but what is very certain is that these advances, if they are paid, will have to come mainly from increased production, the promotion of which is therefore of more use to workers than even the immediate grant of increased pay. What all parties to industry will be compelled by inevitable circumstances to realize is that no source exists to pay advanced wages or even to maintain employment except actual production."

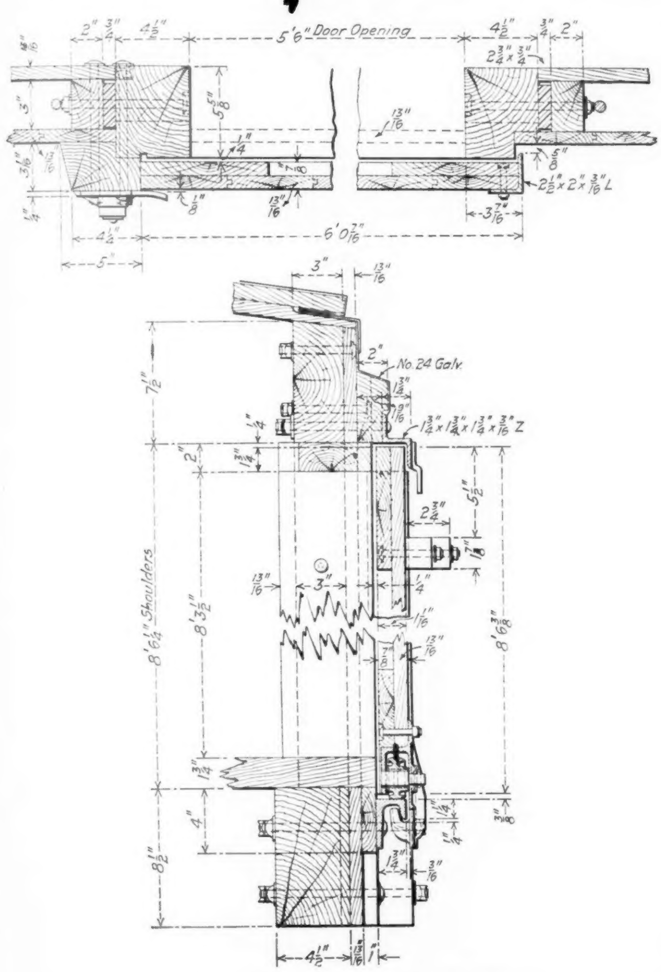
Box Cars Built by C. M. & St. P.

Underframe Has Steel Center Sill and Wooden Side Sills; Wooden Frame Body with Steel Ends

A 40-TON box car in which many interesting features have been incorporated has been designed by the Chicago, Milwaukee & St. Paul, and a lot of 1,000 is now being built in the company's shops at Milwaukee. The general outside dimensions of the car are as follows: length 42 ft. 1½ in.; height at eaves 13 ft. 2 in. and width at eaves 9 ft. 11 in. The inside of the body is 41 ft. 5½ in. long, 8 ft. 10⅜ in. wide, 9 ft. 1⅞ in. high at the center and 8 ft. 8⅝ in. high at the sides with a door opening 8 ft. 2¼ in. high. The cubical capacity of the car is 3,267 cu. ft.

UNDERFRAME

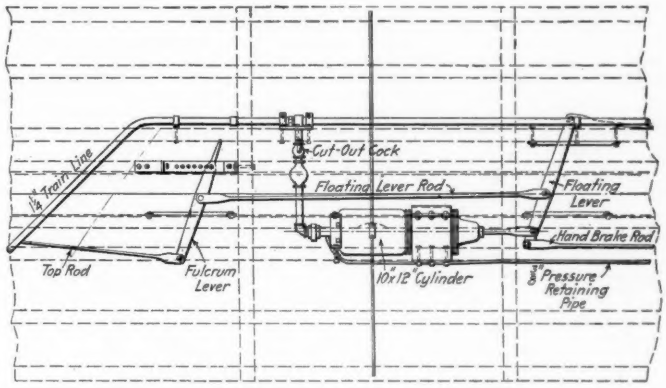
The underframe is made up of a steel center sill with three wooden sills and three truss rods on each side. The center



Details of the Door Construction

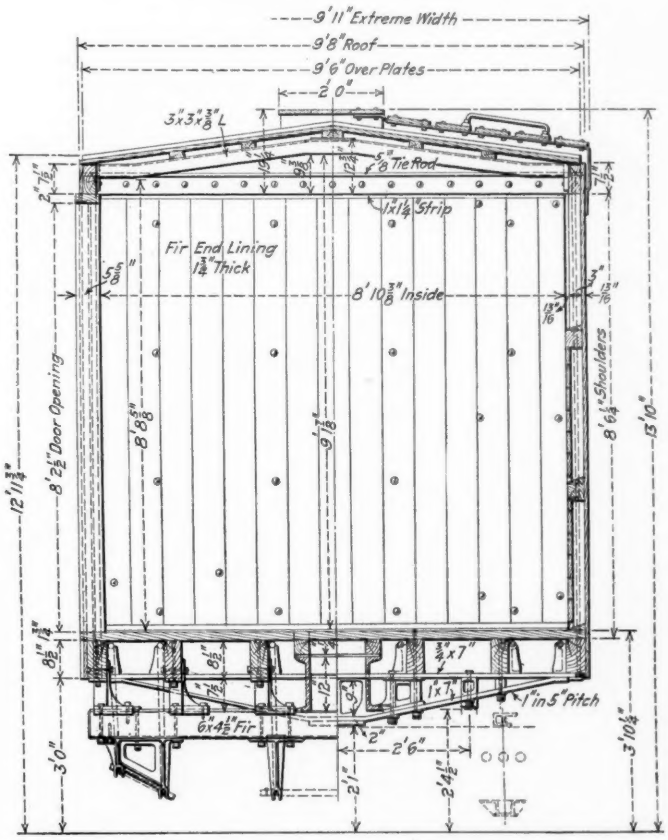
sill consists of two 12-in. 40-lb. channels 43 ft. long with a ¼-in. by 20-in. cover plate extending practically the full length on top of the sill. A double body bolster of the built-up type is used. The top chord members are ¾ in. by 7 in. and pass through the center sill channels near the neutral axis and over a combined filler and center plate casting. The bottom bolster members are 1 in. by 7 in. and pass under the center casting. Malleable iron fillers are bolted between the two members at each intermediate sill and also at the side bearings.

The end sill is of wood, 6½ in. wide by 8½ in. high. It is cut out to a height of 3¾ in. where it passes over the center sill. Two nailing strips 3¾ in. high are bolted along each side of the center sill. With the four intermediate and two side sills, there are eight points of support for the floor boards.



Foundation Brake Arrangement of the C. M. & St. P. Box Car

The sills are all 8½ in. high, the width of the intermediate sills being 4 in. and of the side sills 4½ in. The truss rods are 1¼ in. in diameter, with ends upset to 1½ in. The needle



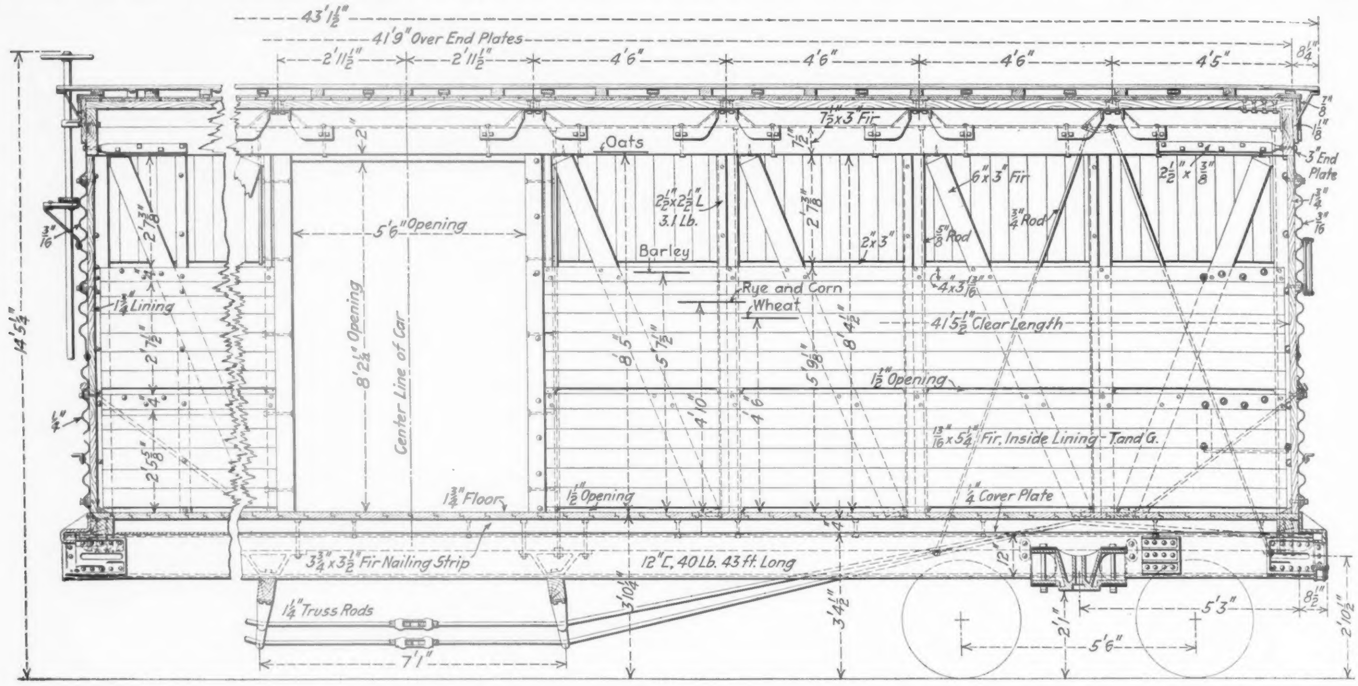
Half Sections of the C. M. & St. P. Double Sheathed Box Car

beams are secured to substantial spacing castings attached to the bottom of the sills.

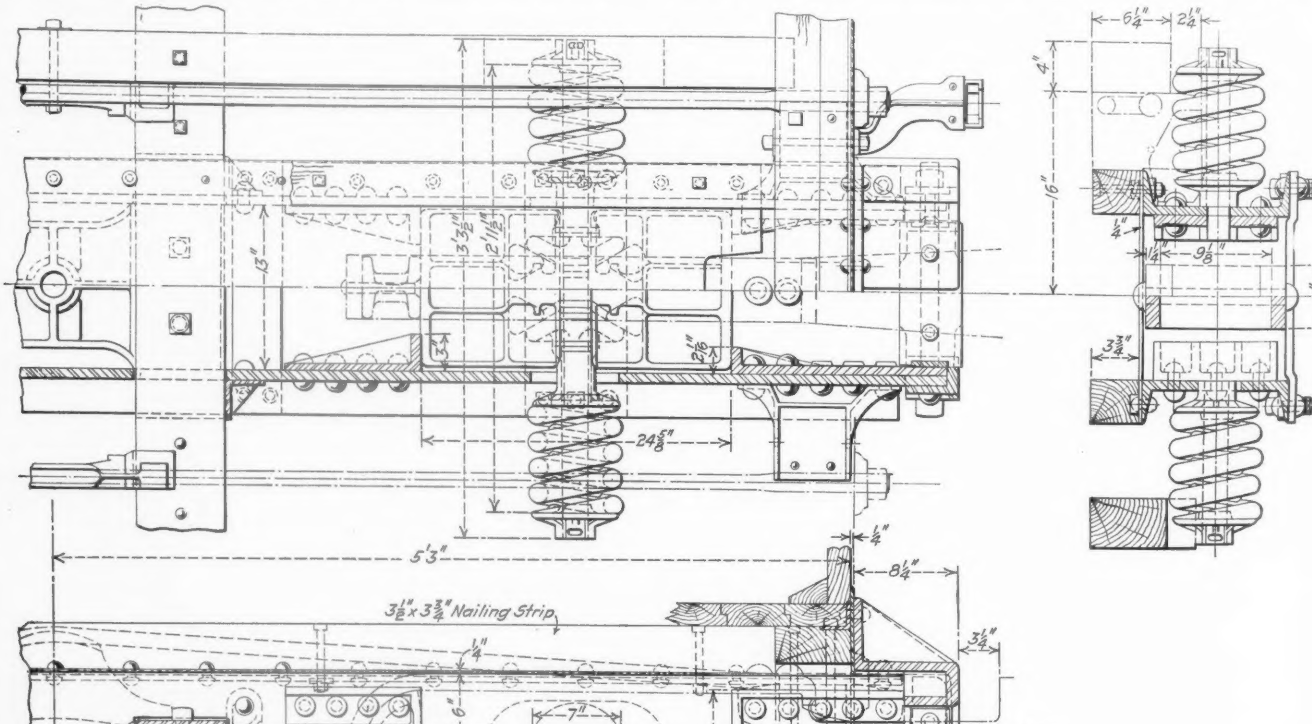
The draft gear is of the Cardwell friction type. One of the illustrations shows the details of the application. A

coupler with a 5-in. by 7-in. shank is used, but slots for a coupler key are provided in the sills.

The side trusses are made up of 6-in. by 3-in. posts and braces, each vertical post being reinforced by a 2½-in. by 2½-in. angle iron, weighing 3.1 lb. per ft. The door posts are made up of a 4½-in. by 5⅝-in. and a 2-in. by 3-in. post with a 2¾-in. by ¾-in. wrought iron strip between. These parts are bolted together and the front door post is further reinforced by the door stop. The side plate is 7½-in. by 3-in. There are two belt rails 4 in. by 3 13/16 in. located 2 ft. 5⅝ in. and 5 ft. 5⅛ in. from the floor. The flooring is 1¾ in. thick, the inner and outer sheathing are 13/16 in.



Longitudinal Section Showing the Arrangement of the Body Framing



Details of the Draft Gear Application

The ends are of the Murphy two-piece type, ¼-in. plates being used for the lower section and 3/16-in. plates for the

upper. The lower plate extends down behind the striking casting and over the end sill and a 2½-in. by 2½-in. angle iron riveted to the plate sets into the upper face of the sill. This construction is clearly shown in the drawing of the draft rigging. Diagonal braces extend from the post pocket casting over the bolster to the top of the lower end section on each side. The end plate, to which the upper section is joined, is 3 in. thick and is fastened to the side plate with strap bolts. The end is lined with 1¾-in. matched boards placed vertically.

The roof is supported on Ideal carlines formed of two 3-in. by 3-in. by ⅜-in. angles, to which are bolted the wooden purlines and ridge pole. The roof is the Murphy type XLA flexible. The doors are of the bottom supported type with Camel door fixtures. Details of the construction at the doors are shown in one of the illustrations.

BRAKE SLACK ADJUSTER

An interesting detail of the brake rigging is the method employed for taking up the slack. No adjustment is provided in the bottom or top rods. Instead, the fulcrum lever is attached to a bracket which has several holes for adjusting the piston travel. The lever is provided with a handle and lettering on the side of the car calls attention to the fact that excessive travel is to be taken up at the fulcrum lever and not at the trucks. The convenience of this arrangement has proved of great assistance in eliminating excessive piston travel.

MAINTENANCE OF FREIGHT BRAKES

Summary of the Instructions to be Published for Distribution by the Air Brake Association

At the convention of the Air Brake Association held in Chicago May 6 to 9, 1919, a comprehensive set of instructions was presented to the association by Mark Purcell as a part of his paper on that subject. In the abstract of Mr. Purcell's paper, published in the *Railway Mechanical Engineer* for June, 1919, page 301, these instructions were not referred to in detail, and a summary of those of the greatest importance is here given.

The instructions outline the practice to be followed in cleaning and repairing air brake equipment on freight cars, and the association finally adopted them as recommended practice, to be published in pamphlet form for sale by the association, with the intention that they be distributed generally to air brake repairmen, foremen and others interested. Before final action to this effect was taken a spirited discussion took place on a number of the author's recommendations, which led to the appointment of a committee, including Mr. Purcell, to agree upon the proper instructions on the points in controversy, which were presented to the association for adoption.

GENERAL INSTRUCTIONS

The instructions specify that freight car brakes are to be cleaned on all repair and shop tracks that are equipped with air pressure for brake testing, and that they will not be cleaned at points where air pressure is not available. All cars marked for bad order triple valves or brake cylinders, or where brakes either will not apply or leak off, are to receive the same treatment as that required for brakes which are out of date. Repairs are to be made, whether their brakes are in date or out of date, on all cars with loose or missing pipe clamps, angle cocks or hose turned out of standard position, loose brake cylinders, auxiliary reservoirs and their supporting brackets, brake rods worn by contact with wheels or axles, and angle cocks which are non-standard in position.

Cars with brakes in date, that is, with a cleaning date less than nine months old, are first subjected to the brake pipe cleaning test, including the branch pipe, the triple valve and release valve. After brake pipe leaks have been remedied the piston travel is adjusted and the brake cylinder tested for leakage. The foundation brake gear is next tested and repairs made to insure that moving parts have ample clearance, that the parts are properly secured and that the levers are standard to the car. The retaining valve is also tested for leakage. If either the triple valve is changed or the cylinder cleaned, the car is considered the same as one with a brake out of date.

Out of date cars, that is, cars having cleaning dates nine months or more old, are treated as authorized for foreign cars by interchange rule No. 60.

PROCEDURE FOR VARIOUS OPERATIONS

The procedure to be followed in carrying out these general instructions is covered by detail instructions for the handling of each part. Only the more important items are referred to here.

Brake Pipe Leakage Test.—Close the branch pipe cut-out cock (except with in-date brakes), and having seen that the opposite angle cock is shut, couple the yard hose, preferably to the retaining valve end of the car, open the adjacent angle cock and charge the brake to 70 lb. Test for and repair leakage from the brake pipe and fittings up to the branch pipe cut-out cock. This includes hose coupling gaskets, leakage under the hose clamp, hose porosity, leakage around the angle cock key under the handle and also the threaded and gasket joints, including the main brake pipe union. With in-date brakes it also includes all of the branch pipe, the triple valve and the release valve. Open and close the angle cock and thereby blow out the brake pipe and the free hose. Listen at the coupler to detect angle cock leakage into the hose, and replace if defective. Then connect the dummy coupling to the hose, open the angle cock and complete the leakage test here. When inspecting for leakage use soap suds where temperature will permit. If connecting with the yard hose or the dummy coupling discloses bent hose couplings, or if hose couplings have broken stop pins, or are otherwise not fit for service, replace the hose.

Piston and Packing Cleaning.—Make certain that the rivets securing the piston to the rod are tight. Remove the packing expander. Turn the flange of the piston packing outward no more than just sufficient to clean the inside of the packing and inspect for cracks, cuts or thin spots that would warrant replacement. Avoid bending any packing more than necessary and clean both sides by dry wiping. If any scraping is necessary use only the dull round corner of the scraper. Kerosene, gasolene and other like mineral oils must not be applied to packing leather, because they remove the filler with which the leather packing is made air-tight, harden and crack the leather, and thus destroy its usefulness. Carefully inspect the piston packing, and if found cracked, cut or worn thin at any point or otherwise defective to cause leakage, replace it with a good one. Note the depression on the packing caused by the expander, as this will indicate any uneven bearing or an expander partly out of place.

Examine the follower for cracks, then measure its diameter, and if it is ¾ in. or more smaller than the rated diameter of the brake cylinder, replace it with one of standard size. If the packing appears good, tighten the follower plate nuts. These nuts sometimes loosen in service and this causes leakage. Clean the joint and flanged portion of the non-pressure head which bolts to the brake cylinder.

Where facilities or conditions will permit, the brake cylinder piston should be removed and taken to a suitable room and cleaned, then tested in a cylinder especially provided for the purpose, this to be followed by the specified test after the piston has been reapplied to the car.

Cylinder Lubrication.—Using the grease brush provided, apply a very thin, uniform coating of standard brake cylinder lubricant to the entire inner surface of the barrel of the brake cylinder, but do not apply any to the piston packing.

Brake Cylinder Reservoirs Loose on Their Supports.—If the brake cylinder moves during application or release, or if any of the cylinder or reservoir bolts are loose or gone, or lock nuts missing, needed repairs must be made by the brake cleaners unless this work has been assigned to other workmen. In this case brake cleaners will not report the brake in good order until any necessary repairs have been completed. One man can observe for movement of the brake cylinder and reservoir and brackets by bleeding off the brakes.

Brake Cylinder Leakage Test.—Use the air gage to test for brake cylinder leakage. With brakes that have just been cleaned, connect the gage to the retaining valve if the latter is the improved type, having the exhaust port threaded for this purpose. On high cars use the ¼-in. hose for making this connection. If the retaining valve is of the weight type, attach the gage to the triple valve exhaust port. In testing in-date brakes, the gage may be attached to the triple valve exhaust port in all cases. Always insure that the plug in the unused exhaust port is tight.

With the brake charged to 70 lb., see that the test gage cock is closed. Apply with a service reduction of 20 lb. and release the triple valve so that the test gage will thereby be connected with the brake cylinder and show the pressure in it. A cylinder pressure of 50 lb. must be obtained before noting the leakage, if any. Try to avoid getting over 60 lb. With the pressure at 50 lb., note the loss of pressure during one minute. If the leakage exceeds 5 lb. per minute with a brake that has just been cleaned, the cause must be found and leakage reduced to not over 5 lb. If it exceeds 10 lb. with an in-date brake treat as an out of date brake—that is, thoroughly clean, repair and test—unless correcting leakage found in the cylinder pipe, cylinder head joint of detached equipment or cylinder head joint of combined equipment reduces the leakage to within the specified amount. The most common sources of brake cylinder leakage are the piston packing, the brake cylinder pressure head gasket, the bottom of the triple valve gasket and, with detached equipment, the pipe connecting the auxiliary reservoir and brake cylinder. With the test gage attached to the retaining valve the leakage may be in the retaining valve pipe.

If temperature will permit, apply soap suds around the piston rod next to the cylinder head. Leaking packing will usually be indicated by bubbles around the rod.

If the pressure rises during the brake cylinder leakage test there is leakage into the brake cylinder past the emergency valve, the check valve case gasket, the triple valve slide valve, the triple valve gasket or an end of the tube in the auxiliary reservoir. If the rise in brake cylinder pressure is three pounds or less per minute, repairs may be omitted, but if it exceeds three pounds, locate the cause and repair before continuing the test for brake cylinder leakage.

Retaining Valve and Pipe Tests.—Test the retaining valve pipe on cars which are fitted with retaining valves not provided with test gage connection or on all in-date brake cars. Turn up the retaining valve handle, charge the brake to 70 lb. and make a service application of 20 lb. Open the bypass in the test hose attachment and, as soon as the triple valve moves to release position, start at the triple valve and quickly apply soap suds to all of the joints of the retaining valve pipe to determine whether they are tight. Repair any defects found and re-set, repeating until the pipe is tight.

To test the retaining valve pipe of cars just cleaned which are fitted with the improved retaining valves, the test gage will be connected to the retaining valve, and the retaining valve pipe may be tested simultaneously with the brake cylinder. Carefully inspect the retaining valve pipe and correct all leakage before condemning the cylinder packing.

After it has been determined that the retaining valve vent port is open, the retaining valve, when turned up, must hold enough pressure to prevent moving the brake shoes on the wheels with the foot within three minutes after the triple valve moves to release position on the brakes which have just been cleaned, and within 1½ minutes on brakes which have been tested only. It is permissible to jar the vertical section of the retaining valve pipe to aid the retaining valve in seating accurately. A special connection equipped with an air gage may be attached to the unused exhaust port of the triple and the retaining valve pipe pressure shown on the gage, in which case the leakage should not reduce the pressure below six pounds at the end of three minutes after releasing the brake for brakes just cleaned, or at the end of 1½ minutes for in-date brakes.

DISCUSSION

The provision in the cylinder test that newly cleaned cylinders do not exceed a leakage of five pounds per minute and, as recommended by the paper's author, but afterward modified, that on in-date cars the leakage does not exceed 10 lb. per minute for cars less than three months old and 15 lb. per minute for cars over three months old, led to considerable controversy and was quite generally discussed. Some of the members considered this test too severe, which the author of the paper admitted to be the case if the average condition of brake cylinders today were to be used as the basis of judgment. The consensus of opinion, however, was that the test was conservative, and a number of members objected to so liberal a leakage allowance for cars with the older cleaning date. Experience of railroads in various parts of the country indicated that a newly cleaned cylinder which meets the five-pound leakage requirement should be able to keep well within 10-lb. leakage throughout the period between cleaning dates. To accomplish this, however, the work must be properly done when the cylinder is cleaned, a defective leather must not be placed back in service, lubricants must be used very carefully in order to avoid the destruction of the leather filler, and attention must be given to insure against leakage around the follower studs. The necessity for the use of good leather and suitable lubricants was particularly emphasized by several members. The difficulty of getting work done of a quality which would reasonably insure the cylinders keeping within the 10-lb. leakage limit between cleanings as brought out in the discussion was from two causes: first, the difficulty of securing competent labor and of properly training men for this work, and, second, the lack of facilities in many places for properly testing packing leathers and pistons for leakage before replacing them in the cylinders under the cars. The printing in pamphlet form of the instructions in Mr. Purcell's paper for distribution among the foremen and workmen concerned, was suggested as a remedy for the first difficulty and action to that effect was finally taken by the association after several revisions had been made. The remedy for the second difficulty is the provision of facilities inside the shop for cleaning and testing brake cylinder piston and packing leathers. Proper cleaning and inspection of packing leathers and pistons is difficult in the yard in all kinds of weather.

THE SAFE MOVEMENT OF EXPLOSIVES*

Duties of Car Inspectors and Repairers in Respect to Shipments of Explosives and Inflammables

BY D. J. O'DEA
Inspector, Bureau of Explosives

THE safe transportation of explosives and other dangerous articles is a subject that has required the attention of various classes of railroad employees throughout the United States and Canada during the past ten years. It is a subject that will require constant attention just as long as such articles are transported, for the dangerous nature of these articles remains the same and they must be treated in the manner prescribed by the regulations if we are to guard against injuries to persons and the destruction of life and property.

Literature consisting of the regulations for the safe transportation of explosives and other dangerous articles, bulletin notices giving the details of accidents that have occurred from time to time through the violation of such regulations and pamphlets showing pictures and sketches of the proper and improper methods of loading and bracing explosives and other dangerous shipments, have been circulated for the use and guidance of railroad employees and shippers throughout the United States and Canada, at various times during the past ten years. This distribution of literature, also our lectures and inspections, has been for the purpose of educating all railroad employees who have anything to do with the transportation of explosives and other dangerous articles, and was occasioned by the numerous serious explosions, fires and casualties that occurred on railroads due primarily to the haphazard manner in which these life and property destroying shipments were handled by railroad men and others who had no suspicions of their dangerous nature. Such deplorable single accidents as that which cut off 23 lives, injured 80 persons and caused a financial loss of over one million dollars, naturally caused public consternation and consequent alarm for the future, as similar explosions were bound to continue with the constant increase in the shipping of such dangerous articles, if uniform and stringent measures for their prevention were not promulgated and enforced throughout the country.

Therefore the American Railway Association, representing all of the railroads of the country, inaugurated the Bureau of Explosives for the purpose of carrying on this work. The regulations governing have been adopted by the Interstate Commerce Commission, which was given authority to act on the subject by a special act of Congress in which is stipulated penalties for violations to the extent of $2,000 fine, eighteen months imprisonment, or both, and if death or bodily injury is inflicted the unfortunate party responsible is liable to receive a penalty of ten years imprisonment.

The regulations for the safe transportation of explosives and other dangerous articles is one of many subjects of railroad literature requiring daily observance by the men on the ground, those men whose individual daily actions mean the operation of our great systems of railroads, and whose individual neglect, blunder, or lack of knowledge could stop operations for a time with questionable results, possible disaster, yes wipe out their own existence as well as others.

The regulations on the whole are voluminous, and would confuse a car inspector or car man who would try to memorize them all when only a small part pertains to his branch of the work, but if each of you will study and observe his own little part of the regulations, you will find them brief and simple, and instead of being a hardship they will give you confidence and satisfaction in knowing your duty and that your action was right.

These regulations have been printed and distributed at great work and expense, and it is a pity that many railroad employees have permitted them to remain within their reach without acquiring the good advice they offer, especially when it pertains to some part of their assigned duties.

It must be remembered that the regulations involve many men and duties both in and out of the railroad service, and the neglect or blunder of any one of the many having to do with the handling of a single shipment would be sufficient to render the work of all the others of no avail. It could be the actual or contributory cause not only of destructive fires, but of disastrous explosions, since large quantities of explosives must be transported, frequently through thickly populated districts and in trains containing cars loaded with other dangerous articles.

The specific duties applicable to car inspectors and car men generally are of the most importance. The essential part of any line of business is a complete knowledge of it; it is folly to expect men to do right by these shipments of explosives and other dangerous articles if they have not been properly instructed and furnished the necessary information on the subject. Unfortunately the car inspectors and car men have been the most neglected class of railroad employees in this respect in not receiving instructions pertaining to their part of the work involved in the regulations for the transportation of explosives and other dangerous articles.

EXPLOSIVES

There are three distinct classes of the explosives and other dangerous articles for especial attention by car inspectors under the regulations, namely: Explosives for which a certified car is required, the inflammables and the acids. These are the placards required on cars containing them, four placards to the car, one placard applied to each end and each door or side. The principal warning on the "Explosives" placard for car men is that portion in large letters: "EXPLOSIVES, KEEP FIRE AWAY." The condensed rules printed thereon for the handling of the car are also well for car inspectors to note and aid in having any violations of them corrected when observed, but this placard must always be accompanied by the car certificate, one on each door.

As the law requires that cars for explosives shall be in exceptionally good condition, so also it requires that they shall be inspected by men who know how and certified to so it will be known that the proper precautions were taken at the originating point. This certificate is to be executed in triplicate, two for the car doors and one to be kept on file at the originating point. There are two portions to the certificate, number one to be signed by the railway employee inspecting the car, which reads:

No. 1.

I hereby certify that I have this day personally examined.................car No..............and that the roof and sides have no loose boards, holes, or cracks, or unprotected decayed spots liable to hold sparks and start a fire; that the kingbolts or draft bolts are properly protected, and that there are no uncovered irons or nails projecting from the floor or sides of the car which might injure packages of explosives; also, that the floor is in good condition and has this day been cleanly swept before the car was loaded; that I have examined all the axle boxes, and that they

*Abstract of a paper read before the Niagara Frontier Car Men's Association.

are properly covered, packed, and oiled, and that the air brakes and hand brakes are in condition for service.

This is practically a legal document, and when a man signs it he is holding himself responsible under the law for the proper condition of the car and should be sure that he knows that the car complies with the requirements of the regulations before he applies his signature.

It seems incredible that a man would sign his name to a document without knowing its reading, but I have found instances where these car certificates have been signed by car inspectors in such a perfunctory manner. A short time ago after a car inspector had completed his inspection of four cars for explosive shipments at a transfer station, I questioned him about the inspection work while he was signing the certificates. He paid no attention to the car numbers nor the number of certificates he was signing, and admitted that he never received a copy of the regulations nor read the car certificate and was signing for something he knew nothing about.

Practically all the car inspectors' duties pertaining to shipments of explosives are covered by one regulation, No. 1662. Considerable wrong has occurred by this class of employees doing their part of the work with their own judgment or ideas as a basis, instead of using regulation 1662 for their guide. Many inspectors considered the roof of an explosive car perfect because it was metal on the inside, whereas the regulations clearly show that the outside needs careful inspection to guard against fires from sparks holding in open or decayed spots. One fire from such a cause exploded a car of 500 cases of dynamite. The outside roof was bad, permitting a spark from a passing train to lodge and set it afire. The placard warning and consequent fear of an explosion kept people away, so there was only a property loss of $7,000. Another fire from the same cause exploded a car load of dynamite, killing two persons and causing a property loss of $8,300. The roof of another car which contained black powder caught fire from a spark of an engine and the fire spread to three other cars on a siding loaded with dynamite. All four cars exploded with a property loss of $10,891.

These heavy losses could have been avoided by the car inspector at the originating point completing his work with the proper inspection of the outside of the roof, or by an inspector at one of the interchange points through which the cars passed detecting the defective roofs. This part that pertains to interchange inspections and many other defects existing during transit with cars containing explosives, emphasizes the necessity of a careful inspection at interchange points as required by regulation 1654 *a* and *b*. In addition to the possibility of defects being overlooked at the originating point, defects are liable to develop during transit.

From the fact that the car inspector at the originating point is called upon especially to inspect a car intended for explosives and is required to sign the car certificate covering such inspection, he knows positively that the car is for explosives and the nature of the special inspection required, but it has been the common practice to assume that during transit the car inspectors would know the explosive car by the placards. In many instances this has proved unreliable, as usually the car inspector is rarely looking up for placards and on account of the infrequency of such placards in some districts, to some inspectors it would be like looking for a needle in a haystack to be looking for cars placarded "Explosives." The most practical way of having a car inspector at an interchange point know the car that contains explosives, in order to make certain that he actually inspects it as such, is to inform him of the presence of such a car.

Part of regulation 1662 reads as follows:

Holes in the floor or lining must be repaired and special care taken to have no projecting nails or bolts or exposed pieces of metal which may work loose or produce holes in packages of explosives during transit.

When packages of explosives are to be loaded over exposed draft bolts or kingbolts, these bolts must have short pieces of solid, sound wood with beveled ends (2-inch plank) spiked to the floor over them (or empty packages of the same character may be used for this purpose) to prevent possibility of their wearing into the packages of explosives.

It will be noted that this only applies to metal so located that it would injure the packages. To condemn a car for use of explosives because it has a metal band across the door sill, or exposed metal in other parts where the shipment would not be placed, is wrong. The regulations are clear on these points, and inspectors must stop adding risks by causing delay to shipments at transfer and other stations through their neglect to follow the printed regulation. Delays of two to four days have occurred at some stations on account of inspectors reporting cars unfit for explosives when as a matter of fact they were condemning cars improperly in this manner.

Of course there is quite a difference in the inspection required by these regulations for a car intended for explosives as compared with the inspection given the ordinary run of cars for merchandise and other shipments. I recall that at one large freight station an agent's faith in the thoroughness with which inspectors examined cars at all times was very much exaggerated, as he felt certain that all his cars were examined as thoroughly as any intended for explosives. The foreman of car repairs at that point expressed his opinion of the difference between such inspections thus: If his inspector spent two minutes looking over a car for the ordinary run of merchandise freight he would discharge him as too slow for the pob, but if he did not spend about three to six minutes inspecting a car intended for explosives he would consider him as not careful and thorough enough for such inspections, for he would expect as careful inspection of such a car as would be given a passenger car. Some cars of course can be inspected faster than others, a metal roof on the outside being easier to inspect than and old wooden roof; rust coated trucks and wheels fairly well worn require a slower inspection than a new or comparatively new car.

While the dangerous nature of explosives and other dangerous articles and the alarming consequences they are liable to cause in their transportation, emphasizes the great importance of particularly caring for such shipments in the manner prescribed by the regulations, it also emphasizes the importance of the car man's duties being thorough with all cars regardless of the nature of the lading. Many train accidents in which explosives and other dangerous articles were involved and through their presence added exceedingly heavily to the injuries to persons and the destruction of life and property, were the result of defective equipment other than that which contained the explosives and other dangerous articles. While the regulations provide that "at points where trains stop and time permits, cars containing explosives and adjacent cars must be examined to see that they are in good condition and free from hot boxes or other defects liable to cause damage," the importance of the car man's duties being thoroughly performed at all times should be constantly remembered.

All explosives are required to be well packed in specified containers when offered for shipment and properly loaded and braced in the cars for forwarding. However, the shocks cars receive incident to yard and road movement sometimes have the effect of breaking the bracing or the packages, permitting the contents to leak or become exposed. The records of our Bureau show many such instances. Therefore, essential requirements are to keep fires away and when inspection or other work at such a car is necessary after daylight hours, naked lights must not be used. Extreme caution must be exercised to prevent the striking of sparks or permitting the friction of tools, bolts, rods or other metal parts of the car to come in contact with loose explosives, or for such metal parts to wear through and damage the packages. A draft bolt was found broken in a car containing fifty cases of dynamite. The car repairer while replacing a draft bolt in the car struck some

of the loose dynamite that settled around the bolt, burning his face and injuring both eyes. A serious accident was narrowly averted. The broken draft bolt may have been due to poor inspection at the loading point.

Many other simple acts have resulted in serious accidents with shipments of explosives. Nitroglycerine, the liquid ingredient of dynamite, leaking from containers through to the wheels and rail, caused it to detonate when the car was moved, exploding all in the car with the loss of several lives any many thousands of dollars' worth of property. One of the kegs in a shipment of black powder was found in a damaged condition with powder strewn over the car floor. After putting back in the keg what could be readily picked up from the floor of the car, the remainder was swept out on the ground. A bystander thoughtlessly threw a lighted match on the ground among the sweepings. There was an immediate flash which communicated to the kegs of powder in the car, with the result that fourteen persons were killed and eight injured. In a similar instance, a way-freight conductor instead of disposing of loose powder in the manner prescribed by the regulations and complying with the warning given on the placard, knew just enough about the characteristic of black powder, as he thought, to have some fun with it. Some powder was loose on the car floor from defective packages, and after picking up most of it he swept the remainder out on the ground. It was on a Southern road where colored men were employed as trainmen, and knowing that the loosely scattered powder would merely flash when lighted, it was thought a fine joke to get a colored man in the center of the scattered powder and then light it. The conductor and some of his men accomplished this and were enjoying a hearty laugh, when suddenly all the powder in the car exploded, killing them and some children who were playing nearby, a total of eight lives sacrificed. In the excitement of the joke, it was not considered that a small spark of the ignited powder would flash up into the car and explode all with such a disastrous result.

Loose or scattered black powder is exceedingly dangerous, and it is very odd how far a trail of it will carry fire when it catches a spark. In the city of Wilmington, a wagon loaded with powder was being driven along the street. One of the kegs had a hole from which powder escaped in small quantities, and a man driving a fast trotting horse two blocks away, crossing the street at right angles, through a spark produced by the shoe of the horse striking a cobble stone, ignited this trail of powder. The fire followed that wagon two blocks, caught up with it and exploded the entire load.

Such instances show the care that should be taken with any trail of powder from leaking packages around freight cars.

HAZARDS OF INFLAMMABLE AND ACID SHIPMENTS

While a mishap with explosives is capable of great destruction, accidents with the inflammable and acid shipments have been the most numerous, and when measured by loss of life, number of personal injuries and extent of damage to property, one of the most disastrous accidents that can be traced to the transportation of dangerous articles, occurred in September, 1915, with a tank car load of gasoline. Forty-seven persons were killed and 524 persons were injured. The property loss was over one million dollars. The greatest hazard with inflammable shipments has been with the movement of inflammable liquids.

Cars containing fireworks, smokeless powder, inflammable solids such as matches, chlorate of potash and various other articles liable to catch fire through friction or by being dropped or crushed or by spontaneous combustion; inflammable liquids like gasoline, liquified petroleum gas, bisulfide of carbon, naptha, benzol, alcohol, and some paints and varnishes; compressed gases such as acetylene, hydrogen, blaugas, hydrocarbon, must be protected by four "Inflammable" placards, one applied to each end and each side.

The three notes on the bottom of these cards are also important. They read:

1. This car must not be next to a car containing explosives.
2. Do not enter with exposed flame, nor with lighted lantern, until car has been ventilated and vapors allowed to escape.
3. When lading requiring this placard is unloaded from box or stock cars, Agents, Yardmasters and Conductors must remove the placards. Tank cars must retain placards until cleaned.

Accidents have happened frequently due to men not obeying these warnings, by car inspectors and others poking a torch, lighted lantern or match around a leaking car or in the dome of an empty tank car. The ordinary trainman's hand lantern is responsible for a large number of these accidents, and car inspectors and others are in the habit of utilizing their torches or hand lanterns for the purpose of making inspections of such cars. It is probably due to lack of knowledge that some fatalities have resulted from the use of such lights in connection with work at night, and employees should be impressed with the importance of observing the caution to keep lights and fires away. A leaking container of any inflammable is a hazard, and the best time to examine it or to do any repair work on a car protected by "inflammable" placards is during the daylight hours.

The inflammable solids or oxidizing materials when combined with combustible or organic matter may cause fires spontaneously. For example, permanganate of potash if it gets out of its package and becomes mixed with organic matter, such as may be found in the ordinary dirt of a freight car, may ignite of its own accord, or when an attempt is made to pick it up with a shovel a spark may be created which may cause ignition of the entire mass.

Inflammable compressed gases if leaking from their cylinders are readily ignited by the presence of an open flame or lighted lantern, and the ignition of these gases may result in a serious explosion and fire that may be far-reaching, for the reason that when the gases mix with the air they form an explosive mixture.

In the treatment of tank cars which are protected by the inflammable placard, or by the acid placard, according to whether the contents are inflammable liquids or acids, their handling deserves careful attention on the part of car men. The regulations require such cars to comply with the Master Car Builders' rules and when they do not their transportation is forbidden. When such cars are set out for M. C. B. defects and in addition may exhibit leaks at the seams, rivets or outlet valves, there is danger of ignition of the vapors escaping from inflammable liquids, or if the leaking liquid is acid, danger of serious burns to railroad employees. It is customary for well instructed men to stop leaks through the seams or rivets of tank cars by caulking the metal, and this can be done with reasonable safety even when the tank is loaded with gasoline. The question of whether bronze rather than steel tools should be used for the caulking has been considered, and our investigation justifies the conclusion that there is no case on record of any serious fire caused by the use of steel tools. Steel tools are more efficient for this purpose. In some instances it would be quite difficult if not impossible to caulk a seam by the use of a bronze tool. Such work on an empty tank car is dangerous, and the best method is not to permit the caulking of an empty tank car until the tank has been steam cleaned, unless it is known that it previously contained a substance that would not cause gas to remain in the tank. If the leak from a tank car is very bad, attempts should not be made to repair it, but the contents should be transferred as quickly as possible to a suitable car.

The presence on the inflammable placard of "Keep Lights and Fires Away" is not always sufficient to act as a warning, and a guard is a more reliable means of preventing the possibility of a serious accident. In a recent case when it was

impossible to stop a leak at an outlet valve, every person in the railroad yard was notified of the presence and location of the tank car. Some employees owning automobiles saw an opportunity of getting gasoline without expense. This operation was performed safely during daylight hours, but when a night yardman came on duty he proceeded to steal some of the gasoline, using his lighted lantern for the purpose of seeing when his container became filled. A very serious fire followed and the employee was badly burned. The presence of an active guard could have prevented this. The Bureau's records show many instances of personal injuries and serious fires caused by employees attempting to pilfer gasoline and alcohol from tank cars.

One of the most dangerous substances handled by railroads in tank cars is casinghead gasoline. The regulations require that tank cars containing this material should bear on the top of the dome cap and on each side of the dome, a special placard reading:

CAUTION

AVOID ACCIDENTS

DO NOT REMOVE THIS DOME COVER WHILE GAS PRESSURE EXISTS IN TANK. KEEP LIGHTED LANTERNS AWAY

The regulations also require that tank cars containing this liquid shall be equipped with a mechanical arrangement for closing of dome covers as called for in the M. C. B. specifications, and this arrangement must either be such as to make it practically impossible to remove the dome cover while the interior of the car is subjected to pressure; or suitable vents that will be opened automatically by starting the operation of removing the dome cover must be provided. One of the most serious accidents in the history of the railroads occurred in September, 1915, due to the opening of a dome cover of a tank car containing casinghead gasoline, although it was known at the time that interior pressure existed.

The regulations require that safety valves on tank cars containing any of the inflammable liquids that give off volatile vapors at or below a temperature of 20 deg. F. shall be set to operate at a pressure of 25 lb. per sq. in., as a safety precaution to prevent the frequent unnecessary escape of the vapor. The Master Car Builders' Specifications for tank cars, with which your duties require you to be familiar, covers in detail the essentials in this respect applicable to the various volatile and acid products.

The regulations require that empty tank cars that previously contained gasoline or any of the other liquids requiring the inflammable placard must retain such placards until the cars are known to have been properly cleaned with steam or reloaded with a substance that does not require the placard. Many fatal accidents have resulted from using lanterns or lighted matches to repair unsteamed tank cars, which may contain inflammable vapors even when the previous lading was not of a flash point below 80 deg. F. Only incandescent electric lights should be used for this examination.

An empty tank car, which had previously contained fuel oil, was being repaired. While a shopman with a lighted lantern stood over the open manhole of the dome an explosion occurred which threw him to the rafters of the repair shop shed and dropping back on the car he was fatally burned, dying a few hours later. A number of other employees were burned by the fire that followed, which destroyed the repair shop and all the cars in the vicinity with a heavy property loss.

While repairing an empty tank car which had previously contained naphtha, a red-hot rivet was passed to one of the employees inside of the tank, which ignited the gases, killing the employee in the tank and seriously burning the other. This car had been empty for seventeen days, but had not been cleaned by steam.

A repairman arranged to rivet a grab iron on the end of an empty tank car which had previously contained gasoline. His helper entered the tank but came out saying the vapors were too strong for him. The repairman then enterd the tank and instructed his helper to hand him a hot rivet. When the rivet entered the manhole an explosion occurred, severely burning the repairman who died two hours later.

Inspection by a car inspector and repairer was being made of an empty tank car which previously contained gasoline. They removed the dome cover to ascertain whether the car contained any liquids and the inspector thoughtlessly struck a match. The vapors were ignited and an explosion followed, severely burning the inspector.

These are only a few of the many similar accidents that have occurred to car men on empty tank cars.

Leaking packages of inflammable or corrosive liquids when observed should be immediately taken care of. If in doubt a call should be made for some authorized and competent railroad employee to supervise the removal of the leaking packages from the car.

PRECAUTIONS IN CASE OF FIRE

The best manner of extinguishing firse depends upon the immediate existing local conditions. Fires caused by nitric acid or mixed nitric and sulphuric acids can be controlled by the use of water. In applying the water care must be exercised as slight explosions may occur, accompanied by the projection of hot acid, which may cause dangerous burns. Therefore, the water should be applied from a safe distance. Sand may also be used to stop a fire started by acid. But if the fire has thus been stopped the early use of water is desirable to prevent the fire breaking out again. Thoroughly flush away any remaining acid and remove leaking and damaged containers. Acid fires give off nitrous fumes which are extremely irritating and are poisonous. Employees should not enter a car or other confined space where such fumes are present.

Fire in a car of friction matches frequently involves ignition of the match heads in only one or a few of the inside cartons. If the outside box is not broken open and the smoke dies away after a moment or two, no further action is necesary as the fire has already been extinguished for want of oxygen, and nothing will be gained by opening the box. If the fire has gained some headway, the burning box or boxes should be removed from the car if this is possible, or water should be freely used. Boxes should not be broken open as the fire will be increased by such action.

Fires in ground charcoal or in charcoal screenings are best handled by removing the burning packages (usually bags). If removal is not possible, water may be used sparingly to extinguish the visible fire; then remove all the charcoal and separate the wet from the dry. The dry charcoal should be stored under cover and under observation for several days before permitting it to be forwarded as it is probable that fire may burst out again. The wet charcoal should be destroyed as it is unsafe to transport. Fires in lump charcoal should be extinguished with as little water as possible and the wet charcoal removed from the balance of the lading. The same precautions as to observation for several days should be followed to see that fire does not occur again.

Fires which involve only a small amount of gasoline can often be extinguished by the liberal use of water, but if there is a large amount of gasoline already ignited, water will only spread the fire. Sand or earth should be used to control the flames of the burning gasoline, and could possibly be used in sufficient quantity to smother the fire.

Fires involving tank cars may occur through ignition of the vapors escaping from the safety valve. The burning of these vapors and even the liquid itself at a safety valve is not a serious matter except as a source of trouble to surrounding property. An effort should be made to promptly extinguish such fires by the use of wet bagging thrown over the safety valve, throwing sand in quantity on top, or if the

means are available, by the use of a heavy jet of steam. If this cannot be done, isolation is the proper course to pursue, and the fire will eventually burn itself out.

If in repairing cars containing dangerous lading it is necessary to disturb the lading, care must be exercised to properly load and brace it before the repaired car is permitted to go forward.

The Interstate Commerce Commission regulations require that carrier's employees shall report all violations of the regulations observed, and car defects constitute serious violations of the regulations which should be reported to the proper railroad official. These reports are our best means of guarding against a repetition of violations before they result in more serious consequences.

As the regulations place upon the carriers a duty to make the regulations effective and to thoroughly instruct their employees in relation thereto, in turn the carriers necessarily hold trainmasters, yardmasters, station agents and those who have men under their jurisdiction, responsible respectively for the proper instruction of the employees under them and for their compliance with the regulations. Therefore, it is essential that chief car inspectors and foremen protect themselves with a suitable means of instructing employees under their jurisdiction and insuring compliance by them with the regulations. The monthly or periodical business meetings of car men that are in practice on some roads affords an excellent opportunity to include subjects pertaining to the regulations for discussion and instruction of the car men, who should be furnished literature pertaining to their part of the duties involved. The use of the accident bulletin issued quarterly by our Bureau also serve as an excellent means of imparting knowledge on the subject.

After proper provision is made for the instruction of employees, it is still incumbent to know that the regulations are actually complied with by them when the occasion arises. Such a knowledge can be obtained by a periodical check of the work of the various employees.

Before any work is commenced on any cars containing explosives or other dangerous articles, it should be the rule that some specially posted employee will inspect the car and supervise the work. By having some system for the handling of these subjects, a chief car inspector or foreman can then have some assurance that he has guarded against trouble or disaster with the employees and property under his jurisdiction.

ALL-METAL PASSENGER CARS FOR BRITISH RAILWAYS*

Before the war the supplies of lumber for rolling stock in Great Britain were adequate at comparatively low prices, but at the present time, the conditions have changed entirely. The United Kingdom has in the past imported about 90 per cent of its requirements but with the decrease in the available vessels since the war the problem of getting the lumber into England has been a difficult one. At the present time the British imports of timber are two years in arrears and on account of the present demand for this material on all sides, it is estimated that it will not be less than five years before the demands for lumber for railway rolling stock can be met as in pre-war days. On the other hand, the metal output of Great Britain has greatly increased during the war and there would be no difficulty in supplying the 20,000 tons of metal per year necessary for the construction of passenger car bodies required by the railway companies. Furthermore, the prices of iron and steel have increased but about 124 per cent since 1914, whereas the price of lumber has increased about 218 per cent. Thus the development of the all-metal passenger car appears to be a natural evolution.

*Taken from a paper presented by F. E. Gobey, assistant carriage and wagon superintendent, Lancashire & Yorkshire, England, before the Institution of Civil Engineers, London.

There are in Great Britain 52,250 railway passenger cars. They are mainly of wooden superstructure. A large number, however, have all-metal or composite, lumber and metal, underframes. Table I indicates, in brief, the general construction of passenger cars on fourteen railways in Great Britain:

TABLE I—SUMMARY OF PASSENGER CARS OWNED BY FOURTEEN RAILWAY COMPANIES, JULY 31, 1918, SHOWING THE AMOUNT OF TIMBER AND METAL CONSTRUCTION

BODIES

Built of	Number of cars	Percentage of total
Timber	46,133	95.9
Timber with metal outside panels	1,761	3.7
Composite, timber and metal	158	0.3
Metal entirely	46	0.1
Total	48,098	100.0

UNDERFRAMES

Built of	Number of cars	Percentage of total
Timber	592	1.2
Timber, with metal plate on solebars	19,750	41.1
Timber, with metal angle or channel on solebars	6,469	13.4
Composite, timber and metal	4,569	9.5
Metal entirely	16,718	34.8
Total	48,098	100.0

The number of cars given in this table represent 92 per cent of total number of passenger cars in Great Britain.

Most of the six-wheel passenger cars have iron or steel plates ½-in. thick on the outside of wooden side sills and the four-wheel truck cars use either the steel plates or angles or channels. In some cases they have composite underframes with rolled steel side sills and bolsters. However, the all-metal underframe and truck has been the standard practice since 1900. The average weight of metal in a modern passenger car, 56 feet long, with a steel underframe and wooden body is 41,500 lb. or 66 per cent of the total weight of the car.

The design of British cars with numerous side doors which break the continuity of the body as a girder, has made it necessary for the superstructure and load to be carried by the underframe. The bodies of this type are designed to keep free from distortion. The underframe is calculated to sustain, in addition to the weight placed upon it, strains due to buffing and drawgear, oscillation, and vibration. The British standard underframe for passenger cars with wooden superstructure is composed of four longitudinal members with bolsters and cross-bars all in the same plane suitably trussed.

TABLE II—COMPARISON OF GENERAL DIMENSIONS OF BRITISH AND AMERICAN MULTIPLE-UNIT ELECTRIC CARS

	Long Island Ft.	Long Island In.	Lancashire & Yorkshire Ft.	Lancashire & Yorkshire In.
Length over body corner posts	54	9¾	..	..
Length over buffers	64	5¾	65	3
Width over body	9	9¾	9	4
Width inside body	9	4½	8	11⅛
Width over cornices	9	11½	9	2
Width over belt rail	9	10¾	9	3⅛
Height from rail to top of roof	13	0	12	4½
Height from rail to top of ventilators	13	8¼	12	8⅞
Height from rail to top of floor	4	4⅝	4	1¼
Height from rail to center of buffers	2	10½	3	6
Center to center of trucks	39	9	45	0
Wheelbase of trucks				
Number of passenger seats	80		95	
Weight of car unloaded	63,100 lb.		64,960 lb.	
Weight of car without trucks	45,100 lb.		42,504 lb.	
Weight of one truck	9,000 lb.		11,228 lb.	
Weight per seat	788 lb.		683.7 lb.	

The only railway passenger cars constructed entirely of metal in Great Britain are those used in the electric service of the Lancashire & Yorkshire, between Lancashire and Bury, which uses the multiple-unit control system. These cars are like the American type of passenger car in that they have the center aisle with the doors opening onto platforms at the ends. However the Lancashire & Yorkshire cars have seating space for five passengers across the car, three on one side of the aisle and two on the other, the aisle being much narrower than

in American cars. The general dimensions of these cars are shown in Table II together with those of similar cars used on the Long Island in its electric service in the United States.

In order to show the small amount of difference in weight between the all-metal, as designed by the Lancashire & Yorkshire for its electric service between Manchester and Bury, and the composite type of construction used between Liverpool and Southport, the dimensions in Table III are given. It should be stated, however, that the cars with timber bodies have an underframe of a heavier type of construction than the all-metal car, the latter being of more recent construction. The elliptical type of roof of the all-metal cars is also lighter than the clerestory type on the wooden cars and, further, there are more seats in the all-metal car which reduces the total weight per passenger seat.

TABLE III—COMPARATIVE WEIGHTS OF ELECTRIC MOTOR CARS

Description	Liverpool and Southport wood cars				Manchester and Bury all-metal cars	
	Third class D.C. motor car		Third class M.U.C. motor car		Third class M.U.C. motor car	
	Ft.	In.	Ft.	In.	Ft.	In.
Length over body	60	0	60	0	63	7
Width over body	10	0	10	0	9	4
Height of car inside, floor to roof	8	0½	8	0½	8	3¼
Height of car from rail level to floor	4	4¼	4	4¼	4	1¼
Height of car from rail level to top of roof	12	7⅞	12	7⅞	12	4½
Center to center of trucks	40	6	40	6	45	0
Wheelbase of trucks	8	0	8	0	9	0
Type of roof	Clerestory		Clerestory		Elliptical	
Number of seats	69		68		74	
Weight of body and underframe, with draft and brake gear	47,110 lb.		51,188 lb.		39,592 lb.	
Weight per passenger seat, body and underframe only	682.7 lb.		752.7 lb		535 lb.	
Weight of two trucks complete	53,150 lb.		53,150 lb.		62,719 lb.	
Weight of other electrical equipment, including cables, per car	6,700 lb.		9,902 lb.		18,649 lb.	
Total weight unloaded	106,960 lb.		114,240 lb.		120,960 lb.	
Weight per passenger seat of total weight unloaded	1,550 lb.		1,680 lb.		1,634 lb.	

The difference in the cost of the two cars mentioned above is slight, the all-metal car costing about 4.8 per cent more than the wooden car with an all-metal underframe.

During the three years the all-metal cars have been in service they have averaged 250,000 miles a year. There has been no weakening of the underframe or superstructure. It was found that where aluminum, which is used for the side panels and roof sheets, comes in contact with Flexolith it will oxidize, and the aluminum in such cases has been replaced with brass. While the cars have not been in service long enough to make any direct maintenance comparison with wooden cars it is believed that slightly less material and labor will be required on the all-metal cars.

As will be noted above these cars are built with aluminum side panels and roof sheets, and it is claimed that a return of 20 per cent a year saving will be made, based on the reduction in weight, and considering the interest on the increased initial outlay. The saving amounts to 1,623 lb. per car.

An aluminum with a tensile breaking load of 24,600 lb. per sq. in. is not suitable to replace steel having a breaking load of over 62,800 to 71,600 lb. per sq. in. for framing purposes but with alloys, of both aluminum and steel, metals of sufficient strength may be used with a reduction in weight.

As regards standardization, aside from the uniformity of width and length, there is little or no advantage in the standardization of the superstructure of a passenger car, for it will last the life of the car. Commercial advantages will be obtained by the use of standard rolled sections, pressings, doors and mouldings, however, in the construction of the car. It is believed that if metal construction is adopted, the old compartment carriage should give place to the car with the center aisle such as is used in America. This type of car for main and suburban electric services in England should have a minimum inside width of 8 ft. 11½ in. This will give more seating space per passenger than the present four-a-side compartment in a side corridor car, as it will allow three passengers on one side of the aisle and two on the other.

From a study of the designs of the center aisle cars, it has been found that the weight of the car per seat diminishes as a length of 65 ft. is approached, due to the excessive girder constructions required for the underframe on cars of such length. A study of the conditions in England discloses the fact that the economic car for a suburban electric service would have a length of 63 ft. 7 in. Such a car with a center aisle with three passengers on one side and two on the other would have a seating capacity of 103 and the weight per passenger seat would be 560 lb. For long distance main line cars additional comfort to the passengers will be obtained by having seats for two passengers only on each side of the aisle.

The all-metal open car has the following advantages over ordinary compartment cars of timber construction:—

(a) Increased inside width due to the framing being thinner.

(b) A body which may be built to the full limit of the load-gage for the paying load.

(c) The deletion of the side corridor and cross partitions, saving 1120 lb. in weight.

(d) Seats will be better occupied, making each car more remunerative, and reducing the weight of trains.

(e) An open aisle, which allows the circulation of passengers, and may be passed along comfortably, even if of less width than an enclosed side corridor.

(f) Few outside doors, reducing initial cost, maintenance, and traffic-staff duties.

(g) Greater strength of car side, which, if desired, may be used as a girder.

(h) Saving of interest by gradual reduction in the present stocks of timber.

(k) Simplification of parts.

(l) Greater safety in case of accident.

There is no comfort provided by the existing main-line small passenger compartment cars which cannot be secured in an open aisle all-metal car. In suburban cars where frequent stops are made, the weight should be reduced to a minimum consistent with safety and proper maintenance. Main-line cars must be built to resist greater stresses and must provide protection for passengers in case of accident.

Automatic center couplings without side buffers have been very successful in the electric service of the Lancashire & Yorkshire during the last 15 years for train speeds up to 60 m. p. h. and the development of the coupler will be to automatically engage also the brake and electric connections. In England practically all the station platforms are elevated a certain amount above the rail to accommodate the side door compartment cars. Thus the conditions are such that on main-line cars steps from the vestibules will be necessary on account of the varying height of the station platforms above the rail level.

While much has been said about the adoption of the open aisle car in contrast with the side door compartment car, it might be said that it is not necessary that the open aisle car be used with the change from a timber to metal construction.

Throughout the discussion of this subject the author frequently referred to the practices followed by the railroads of the United States in all-metal car construction.

PLIGHT OF RUSSIAN RAILWAYS.—The Russian railway system threatens to collapse, owing to the fact that no repairs have been effected since the revolution, says an article in the Reconstruction Supplement of the Review of the Foreign Press issued by the British War Office. The station buildings are for the most part deserted, the warehouses falling in, and the central switches and signaling apparatus no longer work, owing to the lack of spares with which to replace the wornout parts.

SHOP PRACTICE

FURNACE FOR BRAZING COPPER PIPE

BY E. A. M.

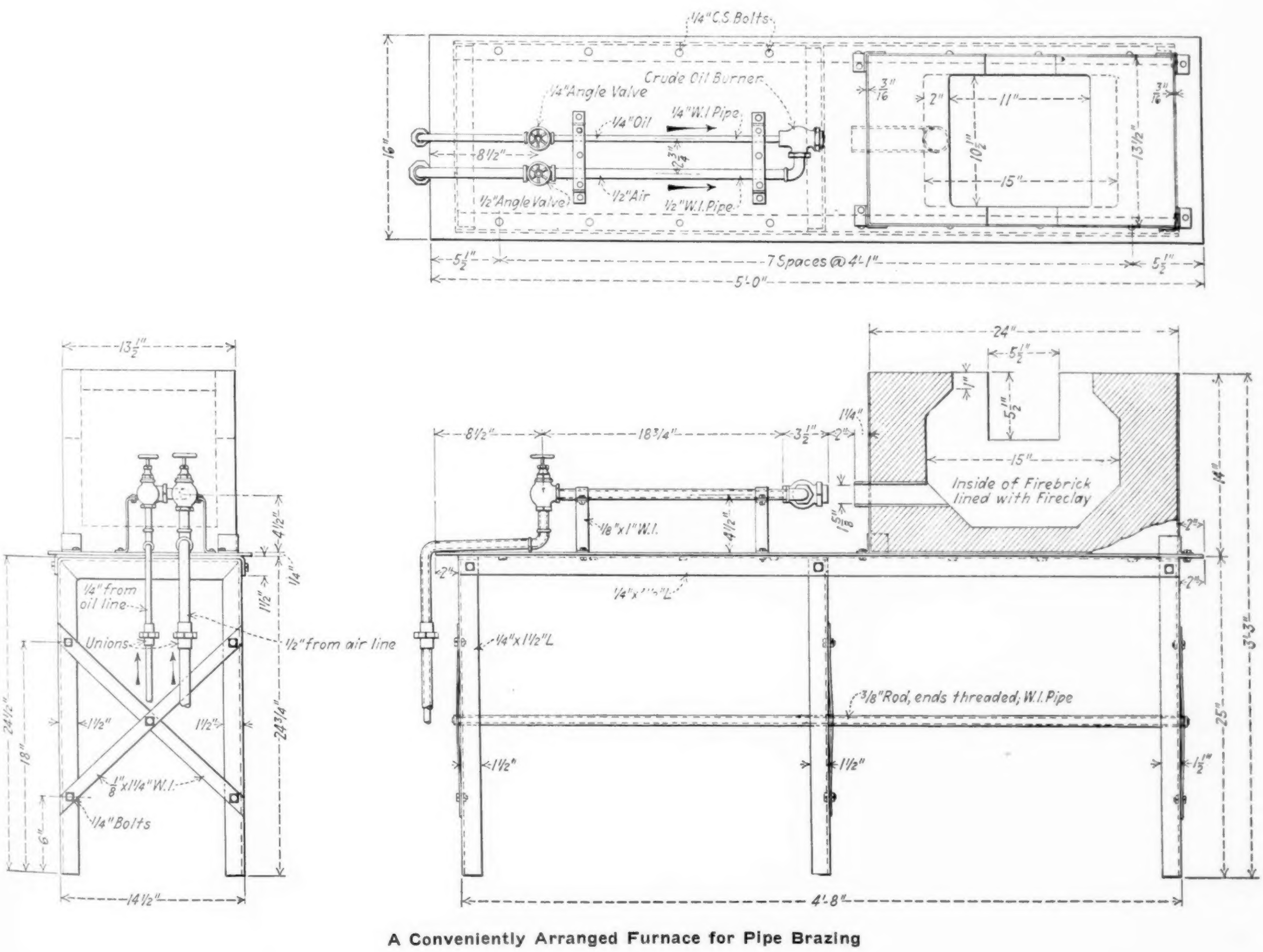
The furnace shown in the drawing is a shop made device which should prove very convenient for use in brazing copper pipe.

The furnace itself occupies a space measuring 24 in. by 13½ in. and stands 14 in. high. It is mounted on a rigid table, built up of angles, flat sections and tie rods in wrought iron pipe sleeves, and is covered with a top of ¼-in. steel or iron plate. The table is 4 ft. 8 in. long and just wide enough to conveniently hold the furnace at one end. The remainder of the top holds the burner and the air and oil supply pipes and control valves.

The furnace box is built of ⅛-in. or 3/16-in. sheet metal, with angles on the outside of the corners. It is lined with firebrick and the combustion chamber is finished with fire clay applied to the brick. Openings 5½ in. wide by 5½ in. deep are cut through the sides of the furnace to permit the pipe to be passed through the combustion chamber. The top of the box is left open, but a piece of plate may be provided which will serve as a cover when desired.

Through one side of the furnace, near the bottom of the combustion chamber, is a 1⅝-in. pipe. This forms an opening in front of the burner, which is held in position by 1-in. by ⅛-in. iron supports from the top of the table. The burner is fed by a ¼-in. oil supply pipe and a 1½-in. air pipe, controlled by angle valves. The valves are located above the top of the table about two feet from the end of the furnace. As shown in the drawing, the device is intended to use crude oil.

This furnace has been used very successfully to handle up to 4-in. copper pipes and no doubt could handle even larger sizes if occasion required.



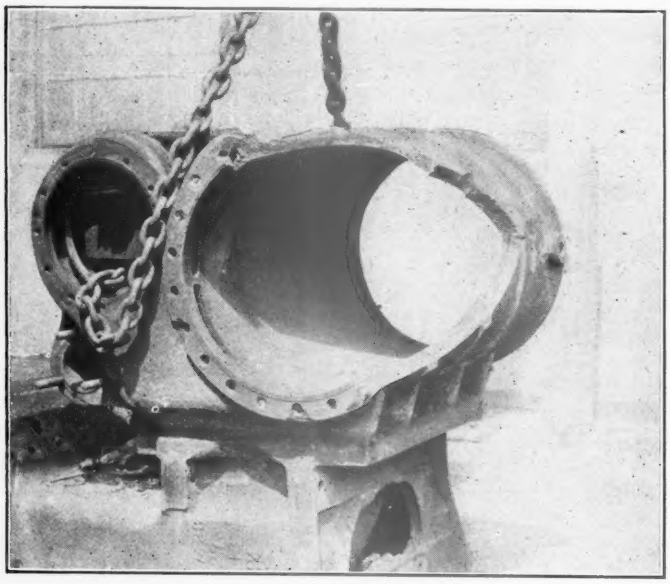
A Conveniently Arranged Furnace for Pipe Brazing

WELDING LOCOMOTIVE CYLINDERS

BY J. B. TYNAN
Superintendent Shops, Wheeling & Lake Erie, Brewster, Ohio

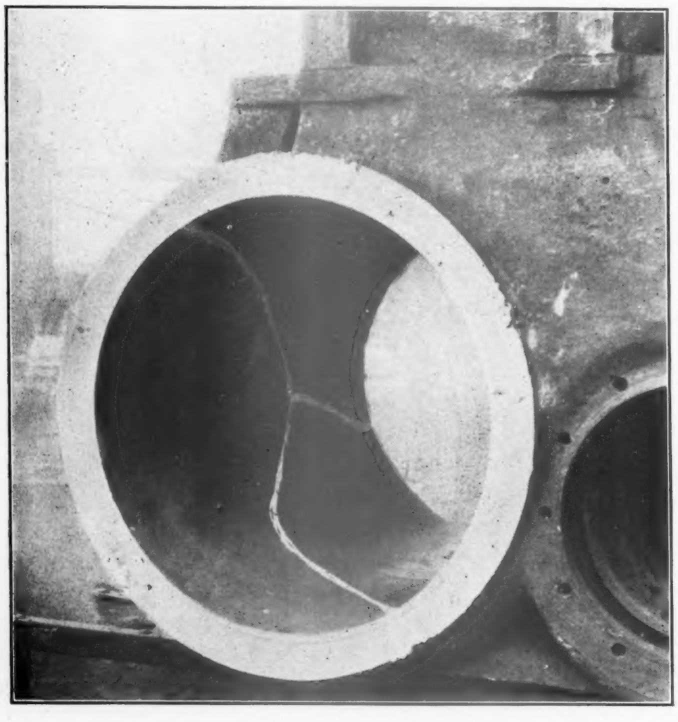
The possibilities of reclamation by welding are forcibly illustrated by the repairs made to a locomotive cylinder casting in the Wheeling & Lake Erie shops at Brewster, Ohio. A cylinder casting having a large section of the barrel broken off, was successfully repaired by gas welding.

In making repairs to this cylinder a pattern of the missing



The Broken Casting as Received in the Shop

part was first made and a patch casting, weighing 505 lb., cast from iron scrap. The rough edges of the cylinder were chipped to an angle of 45 deg. and the patch fitted and



The Cylinder Casting After Welding and Boring

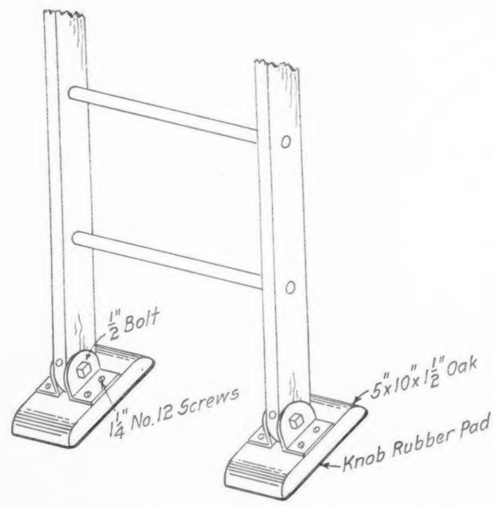
bolted into place. A furnace of brick was then built around the cylinder, with an opening at one end large enough to admit an oil torch, and the entire casting was brought to a red heat before the welding was begun. The patch was then welded to the cylinder and the old stud holes also welded shut. An oil burner was kept burning inside of the cylinder until the welding was completed.

After the welding was completed the furnace was filled with pine wood and the cylinder kept at a cherry red heat for seven hours. The furnace was then closed as tightly as possible and the cylinder allowed to cool slowly. After being thoroughly cooled, the cylinder was bored and the face finished ready for new stud holes. This method of repairing gave satisfactory results and eliminated a long wait for a new cylinder casting, thus enabling the shop to turn this locomotive out for service in a comparatively short time.

SAFETY NON-SLIP SHOE FOR LADDERS

BY A. G. JOHNSON
Mechanical Engineer, Duluth & Iron Range, Two Harbors, Minn.

A safety non-slip shoe for use on ladders is shown in the illustration. This shoe is made of hardwood blocks with two clips of No. 10 gage steel plate, formed and drilled, and attached to the ladder as shown. These plates may be selected from boiler shop scrap. A pad of rubber is glued and then nailed to the underside of the hardwood blocks, which



Application of the Non-Slip Ladder Shoe

prevents the ladder from slipping while being used on a hard or smooth surface. These shoes have been in use in the shops, roundhouse and power plant of the Duluth & Iron Range for a number of years and have given very satisfactory service when used on concrete or other hard floors, preventing slipping of the ladder and possible injury to the person using it.

RUSTLESS STEEL.—A new Sheffield invention is a rustless steel having a bright surface and able to resist the corroding effect of air, water and acids without staining. It was chanced upon largely by accident, just prior to the outbreak of the war and was immediately commandeered by the British government for use in airplane construction and for purposes where strength and durability, combined with rust resisting qualities were invaluable. A local metallurgist, Harry Brearly, author of numerous standard works, was experimenting in the armament shop to find a means of preventing erosion in gun tubes. After some of his experiments he noticed that certain pieces of chrome steel had not suffered from corrosive influences under conditions which would have rusted ordinary steel. He followed up this clue, and what is known as stainless steel was eventually worked out and added to Sheffield's metallurgical triumphs.—*Scientific American.*

Master Blacksmiths' Convention

Papers on Heat Treatment of Steel, Autogenous Welding, Spring Making and Shop Equipment

METHODS of securing increased production in the shops and increasing the service secured from forgings were the principal topics discussed at the twenty-fifth convention of the International Railroad Master Blacksmiths' Association, held at the Hotel Sherman, Chicago, on August 19-21. The convention was opened with prayer and an address of welcome, following which the president, W. C. Scofield, delivered an address which reviewed briefly the developments since the last meeting in 1916.

PRESIDENT'S ADDRESS

Mr. Scofield said in part: In reviewing the great world conflict, our craft can with reasonable pride, look at the many monster guns, munitions and engines of war, and know that their ingenuity and brawn helped in making these mighty implements. In the present upheaval let us forget the fallacies of socialism, the ignorance of bolshevism, and the utter nonsense of the soviet, and return to the principles of our fathers and realize that the safety of our institutions, the success of country, and the happines of our home, depend not so much upon how much we can get, but upon how much we can do.

W. C. Scofield (Ill. Cent.)
President

J. Carruthers (D. M. & N.)
First Vice-President

G. P. White (M. K. & T.)
Second Vice-President

COST ACCOUNTING IN BLACKSMITH SHOPS

BY G. F. HINKINS
Westinghouse Air Brake Company

A paper touching on the history of the association and the duties and responsibilities of its members was submitted by G. F. Hinkins. In concluding his paper Mr. Hinkins made a plea for more thorough methods of computing the cost of work, which is given in part below:

As a rule, the foremen blacksmiths have every qualification for handling shop work. By that I mean that they possess executive and mechanical ability, but how many understand the fundamental principles on which their business is conducted? Of course, they can tell the flat labor cost of their product, but do they know the overhead expenses? This is a very complex proposition. The overhead for making a flat chisel is much less than the overhead for making an intricate drop-forging, by reason of the high first cost and upkeep of the dies. The overhead expense of producing different forgings varies in accordance with the nature and shape of the forging, as the shape of the forging will determine the cost of both the drop forging and trimming dies. Drop forgings on account of their shape and refinement will influence the life of the die. The maximum output from a set of dies will vary from 10,000 to 50,000. In order to get the cost of the product, it is necessary to get the first or original cost of the dies and also the number of times the dies are dressed before they are worn out and the number of forgings made from these dies. It will be perceived from the foregoing that everything that is necessary to produce a forging must enter into the cost of that forging.

There must be business methods for ascertaining the true cost of doing work, especially if manufacturing is being done for the market. If a furnace needs repairing and the brick mason helps himself to a load of fire brick to repair it and does not charge the brick against that furnace, then some part is not charged for something it did get and some other part is paying for something it did not get. The upkeep of the various types of equipment such as steam hammers, drop hammers and forging machines will differ and the expense for repairs must be kept separate which is done by charging such items against the individual machine. Every machine and furnace is designated with a shop or machine number so that all repairs and renewals are charged against the equipment. In this way, the cost of maintenance of every machine and furnace is known. This is a necessary feature of a cost accounting system which gives the cost of any manufactured article. You may manipulate your charges as you please, but you cannot get away from the cost. Your firm pays the bill.

DROP FORGING AND ITS POSSIBILITIES

BY J. D. BOYLE

The following is an abstract of the paper on this subject: Steel is not a simple substance like pure iron, gold or copper, but a complex artificial substance. It is composed of groupings of elements which enter into its makeup. These elements are only visible with the aid of a microscope. The term micro-structure has been given to what is thus brought to view. Upon polishing and etching a piece of steel the structure is apparent through the action of the etching medium, (acid or other corrosive materials) which affect the elements

variously, causing each to assume a color or structure peculiar to itself.

When steel is heated above its critical point for the forging operation and submitted to blows under the hammer the molecules of the metal are forced apart. To bring the steel to its greatest maximum strength a proper scientific heat-treatment is needed. This is accomplished with proper furnaces, heat measuring instruments and trained workmen. With all the above-mentioned facilities, automatic signal pyrometers, well-designed cooling systems and semi-muffle furnaces designed for this purpose should be used. Heat-treating departments of this type are built to insure quality and progressive production. The materials going into the vital parts of a locomotive should be subjected to a chemical analysis and a heat-treatment applied. After heat-treatment, test specimens should be taken to determine the physical characteristics.

DISCUSSION

H. E. Gamble (Penn.) told of the wide variety of work made under drop hammers. At the Juniata shops hammers ranging from 1,500 to 12,000 lb. are in use and the capacity of the largest size has been overtaxed. All reciprocating parts for locomotives are heat treated after they are drop forged. G. Fraser (A. T. & S. F.) stated that a steam hammer could be used for drop forge work by making dies similar to those used in the drop hammer. The dies are held in a box tool secured by a band and hung in the frame. Several members stated that this method was being used with satisfactory results. O. Schutze (C., M. & S. P.) told how drop forge dies had been adapted to use in a Bradley hammer for making spring hanger gibs. Ample clearance must be allowed to dispose of surplus material, otherwise the dies will have a short life. Attempts to make drop forgings under a hydraulic press had proved unsuccessful. There was some discussion regarding the best material for piston keys, and it was agreed that tire steel was the most satisfactory for this purpose.

REPAIRS TO LOCOMOTIVES FRAMES

BY P. T. LAVINDER
Norfolk & Western

Cast steel now having practically taken the place of wrought iron frames brings into the question of frame repairs a great many new features. The subject of repairs to an engine frame should be carefully considered from all sides. We should be governed by the results obtained by the most successful methods in repairing frames. The shops must be prepared to do this work in a quick, easy manner, keeping in mind at all times the safety of the employees. All the skilled help that is required to do this work must also be provided and the man in direct charge of, or the man doing this work, must be personally interested in it.

At the Roanoke shops of the Norfolk & Western, the following method of repairing frames is being used with great success: It was formerly the practice to use electric welding exclusively in repairing locomotive frames with the exception of welds made in the smith shop forge. In making electric welds the procedure was as follows: The frame was cut from both sides at angles of approximately 45 degrees. The frame was expanded from 3/32 in. to 5/32 in. depending on the size of the frame; using a portable grinder on the scarf where the weld was to be made, cleaning it to secure good bright metal. Welding was begun at the bottom of the scarf, one operator working on each side of the frame. Care was taken to keep the weld free from oxidization and scale as much as possible, by the use of a wire brush, and when the weld was completed it was annealed.

The Roanoke shop has made 19 oxy-acetylene welds on locomotive frames in the past 60 days. This is the first frame welding done at this shop by this process. No failures have been reported up to this time, and it is believed this method will prove very satisfactory. In making welds by the oxy-acetylene process on locomotive frames the following method is used: First, the frame is trammed over the break with a long tram, care being taken to use a tram long enough to keep clear of the heat. Second, the frame is cut from both sides in a V-shape at angles of 45 degrees. Third, the portable grinder is used on the scarf, where the weld is to be made, cleaning it to good bright metal. Fourth, the frame is spread for expansion allowing 1/4 in. to 9/32 in. according to the size of the frame. Some acetylene welders allow far less expansion than others, but we believe that a frame welded a little too long is much better than one too short. More expansion should be allowed when a furnace is used around the frame for preheating purposes. Fifth, the expansion blocks are covered with asbestos in case they are liable to get hot. Sixth, a piece of boiler plate is cut and placed under the frame at the location of the weld. Seventh, the frame is heated with a welding blow pipe or preheated with an oil burner. Eighth, welding is started at the bottom of the scarf, the operator on each side of the frame bringing the metal out to the desired thickness and proceeding up the scarf. This is necessary as a welder should never go back over a weld to apply more metal. When the weld is practically completed the spreader block is removed. This is necessary as the weld is getting shorter just as soon as welding stops. If a lower rail is to be contended with, it should be heated to a good cherry heat, thus allowing the top and bottom rails to contract evenly, removing all strains. Expansion and contraction must be governed by the welders, as some welders are faster workers than others. Frame welding, whether by the electric or oxy-acetylene process, should be done by the most competent operator available as the success of the work depends entirely upon the operator.

In conclusion I would recommend that when an engine comes into the shop for heavy repairs and the frames have been welded four or five times, the frame not having been taken from under the engine at the time the welds were made that the frame should be taken down and put in the smith shop. All welds previously made while the frame was under the engine should then be cut out and worked over and the frame made to proper dimensions. One leg of every brace should then be heated midway between the top and bottom of the rail to a red heat. By this method all strains in the frame that have been caused by welding or otherwise will be released.

DISCUSSION

There was a prolonged controversy regarding the best methods for expanding frames preparatory to welding. Some stated that the bottom rail should never be heated to secure expansion in the top rail, as it was unnecessary and caused the rail to shorten. G. W. Grady (C. & N. W.) criticized the practice of welding from the bottom of rail due to the uneven heating of the section. He advocated welding out from the center to keep the same heat at the top and bottom of the rail. Good results have been secured by this method without annealing after the weld is completed.

PURPOSES AND RESULTS OF THE HEAT-TREATMENT OF IRON AND STEEL

BY GEORGE HUTTON
New York Central

Heat treatment as pertaining to railroad work in railroad shops seems to have gone backward during the past three or four years. When first introduced on locomotive work it was thought this method was going to create a great improvement in the quality of forgings over the hit or miss method. The method in vogue today is for the forge shop

to construct the different forgings and send them to the various departments to be machined to size and then applied to the locomotive without any record or any means of knowing if these forgings are of equal strength or of uniform quality.

These are the existing conditions today. In forging side rods, piston rods, rod straps or any piece of work that may be important, you endeavor to have these forgings made up by the best workmen you may have, and to exercise great care in heating and hammering them. You may also be cautioned, and caution your men to have them carefully annealed and laid on the floor stacked in such a way as to cool off equally, so that machining may be best accomplished. When you have carefully looked after this you have forgings that will only stand up to a strain equal to the strength of annealed material. Remember, annealing weakens forgings.

You will remember when vanadium steel was introduced in railroad work about the time when heat-treatment was also introduced or brought into shop practice. Why was heat-treatment confined to the alloy steel only? The steel makers furnished a steel which, if no heat-treatment was applied, would not be any better or any different from the annealed open-hearth steel, generally in use before the time of alloys or the open hearth in use today.

You have, no doubt, noted the breakage of alloy steel forgings that may have come to your shop off the road that had been heat-treated, and I am positive in my opinion that your verdict was, "Too hard; brittle; too hot when quenched; not drawn back enough," and this is exactly what has set back or almost killed the wonderful results of heat-treatment especially on alloy steel. The average result of this method has been a sacrifice of elasticity for tensile strength. I am of the opinion that when the alloy steel was introduced it was never meant that forgings should be treated to such an extent that breakage was the natural result, but certainly this has been the case.

During the 1915 convention in the discussion on heat-treatment, one member remarked that if we make our forgings, get the proper heat and proper hammering we would have much better forgings than any of the heat-treated ones. If we could only attain efficiency of that kind the whole problem would be solved. But who are the craftsmen who could do it and put it in effect in all our smith shops? There is too much left to guesswork when that method is compared to heat-treatment. When heat-treatment was introduced the main object was to get strength, durability and uniformity, and also to reduce the weight of forgings and castings, and to a great extent this has been accomplished with the exception of securing uniformity, and that is what we are trying to attain with this method.

Heat-treatment of locomotive forgings is a very different practice in comparison with heat-treatment on automobiles or trucks or any light forgings in other industries. We must all admit that the automobile builders have been successful. It has been proved that we can get the desired strength and also the endurance test on some forgings, and several shops have been very successful on all forgings they have heat-treated, but failure has been the result in the majority of shops. I believe it has come about through the fact that all the experiments were on alloy steel only. The greatest trouble is to attain uniformity in heavy forgings. Aside from all the discouraging features of heat-treatment that are found in the average railroad shop, I believe it is a method we should all endeavor to learn more about.

There are many obstacles which are detrimental to successful heat-treatment of locomotive forgings in railroad shops. There is the cumbersome equipment and space which is essential to success. There are very few shops that could readily be prepared to treat even the lightest of forgings. Then there is the output to be considered and the extra help required. But considering all the obstacles and expensive equipment I believe it would prove a good investment when the method was thoroughly understood.

If heat-treatment was introduced in your shop, what would your opinion be, for or against it? If heat-treatment was introduced in your shop, what effect would it have on your output? What extra help would you require? What extra time would you require (if any) to complete a set of rod straps complete, heat-treated? These are questions that we should be interested in and may be asked any time regarding this method. I would like to hear the opinion of different members on this subject. I am sure there are a number of shops that have tried it out to some extent.

DISCUSSION

There was considerable difference of opinion regarding the advantages secured by heat-treatment. H. E. Gamble (Penn.) stated that in addition to improving the quality of the steel, heat-treatment brought out defects. G. Fraser (A., T. & S. F.) stated that he considered annealing preferable to heat-treatment. While heat-treated parts showed high tensile strength they seemed to break down under the vibration to which they are subjected in actual service. W. C. Scofield (I. C.) attributed much of the trouble experienced in using heat-treated parts to the unequal rate of cooling in light and heavy sections. Large forgings are heated above the critical temperature, to treat the material in the interior of the section, and are then quenched again at a lower temperature to take care of the outer layer. Mr. Scofield thought that the high temperature might do more harm than good, and suggested that this explained why small parts have given splendid service after heat-treatment, while larger parts have often failed. George Hutton (N. Y. C.) stated that the New York Central has heat-treated material for three years, and he had still to hear of a single failure. A motion was adopted stating that it was the sense of the convention that wherever heat-treatment can be done it is a success.

SPRING MAKING AND REPAIRING

BY J. W. RUSSELL
Pennsylvania

The question of springs for locomotives in any up-to-date repair shop is one of the most important items that we have to consider because if the proper methods are not used the making and repairing of springs becomes a very expensive proposition. There are so many different ways in which the spring plant may be utilized for economy or waste, that it is incumbent upon the man in charge to put forth every effort in order to obtain the most desirable method. In the first place, we should use all the machinery possible in this class of work, because of the resultant speed and accuracy. The use, also, of all scrap steel that has not deteriorated to any great extent from re-working is economy. The plates should be annealed and cut to desired length; the long plates cut for short ones, and they in turn formed into spring clips, etc. Care must be exercised in examining and selecting this scrap steel in order to avoid reclaiming into service plates that are checked or cracked.

At Renova shop we have followed the method as outlined above and have obtained very good results. We do the spring work for the entire grand division, which requires an output of approximately 400 springs per month. Our new steel is purchased under Pennsylvania Railroad specifications of .90 to 1.15 carbon. We shear the plates to length and cut off the corners cold on a No. 7 Hilles and Jones shear, located in the smith shop, after which the material is delivered to the spring plant where the nibbing, cambering, hardening, drawing, banding and testing are done. We use oil for fuel in all operations except drawing, which operation is done by the use of sodium nitrate. We find that sodium nitrate will stand a heat up to 1,000 deg. F., at which point

we draw all our heavy plates for one hour. The lighter plates are drawn at 900 deg. F. for 45 minutes. Incidentally, I might mention that we found it necessary (when using the sodium nitrate treatment for drawing these plates) to plunge the hot plate into a bath of water to remove the sodium nitrate that adheres to it.

The following table is used by us in heat treating springs,

TEMPERATURE OF BATH AND TIME REQUIRED TO HEAT TREAT SPRINGS

Size of plates	Deg. F.	Time in bath, minutes
4½ in. by ⅜ in.	925	45
4½ in. by 7/16 in.	925	60
4½ in. by ½ in.	990	60
3½ in. by 7/16 in.	900	45
5 in. by ½ in.	950	60
5 in. by ⅝ in.	1,000	60
6 in. by ½ in.	950	60
4 in. by ⅜ in.	925	45
6 in. by 7/16 in.	950	60
3½ in. by ⅜ in.	925	45
3½ in. by ¼ in.	900	30
5 in. by ⅜ in.	925	45
3 in. by ½ in.	950	60
3 in. by 7/16 in.	950	45

after which is given a tabulated statement showing the transverse test of individual plates, giving the deflection and breaking angles.

In order to make the transverse test, one plate is taken from each heat and submitted to the test, using the span and deflection shown on table for that particular thickness

SPECIFICATIONS FOR TRANSVERSE TEST OF SPRING LEAVES.

Thickness of steel	Transverse span to be used	Deflection test in 100ths of an in.	Breakage test minimum angle of breakage, deg.
¼ in.	18 in.	104	63
5/16 in.	18 in.	83	50
⅜ in.	18 in.	69	42
7/16 in.	24 in.	114	36
½ in.	24 in.	93	31
9/16 in.	24 in.	82	28
⅝ in.	24 in.	74	25

of leaf, and if the leaf does not take a permanent set of more than .02 in., it has an elastice limit of not less than 120,000 lb. per sq. in. and is then broken. If it breaks at an angle not less than that shown on the table for that thickness of leaf, it is accepted.

The next operation is assembling and banding. We use a hydraulic assembling machine in connection with the hydraulic banding machine, having a pressure of 1,500 lb. per sq. in. After the band is applied, the spring is placed in such a position that a stream of water cools off the band. The spring is then tested, and if found all right is dipped into the paint vat and placed in storage. Our furnaces are equipped with the Stupokoff pyrometers, using the platinum, platinum-rhodium couples. These pyrometers are checked once each month against a standard test pyrometer, which instrument is checked against a laboratory pyrometer.

DISCUSSION

Several members expressed the opinion that spring making was carelessly handled in many shops. The part of the work which is most often neglected is drawing the temper, although uneven heating and cooling when hardening is not uncommon. J. W. Russell (Penn.) stated that the use of strong bands on trailer springs had been found advisable. The application of rollers between the band and the spring seat also added to the life of springs. Good fitting is essential and wide openings between the leaves were condemned as detrimental to strength.

AN UP-TO-DATE RAILROAD BLACKSMITH SHOP

BY GEORGE FRASER
A. T. & S. F.

The location of the blacksmith shop is an essential feature not only as it influences the design and arrangement of the building and the layout of the tools, hammers, forges, etc., but also as affecting the output of the shop. The nature of the work and the conditions surrounding it require the building to be in an isolated location in order to provide light and air on all sides. In repair work much material travels from the erecting and assembling shop to the blacksmith shop and back again, especially in locomotive work. A large proportion of the material passing between the locomotive and blacksmith shop is heavy and bulky. For this reason the blacksmith shop should be so situated in relation to the locomotive department as to provide for movement over the shortest and most direct route. Such material is usually transported on push cars and trucks so that distances are important in economizing time and increasing output.

From the standpoint of shop production, the blacksmith shop is looked upon as a feeder for other shops of prime importance. Sometimes this is overlooked in preparing the original plans, and the average blacksmith foreman is never consulted with regard to them, so when the shop is completed he is invited into it, and it is up to him from then on to make the best of it.

The blacksmith shops at the principal shop plants of the large railway systems turn out the forgings entering into the construction of new cars, and the bulk of the car forgings required in keeping up the repairs of both freight and passenger car equipment on the line, as well as the forgings for locomotive repairs. As there is a difference in the nature of the work for the two departments, each should occupy a section common to itself, and the machines, forges and equipment should be arranged accordingly. Naturally the equipment for each department is situated in that portion of the blacksmith shop building nearest to the principal shop which it serves. A ground plan in the shape of the letter L is a convenient arrangement for the blacksmith shop, accessible to both the locomotive and car departments. The many conditions affecting the demands upon the blacksmith shop and the differences in the dimensions of the shops on the various railway systems render it impractical to attempt to give a definite proportion based upon any given unit.

The introduction of cast steel in many details for which forgings were formerly used almost entirely has affected the necessary size of the blacksmith shop so far as the locomotive department is concerned. The increased scope of forging machines assisted by the extended use of formers and dies for rapidly duplicating standard parts of cars has increased the possible output of car forgings without enlarging the area required by the shop building.

A general practice has been to span the entire floor without providing intermediate supports for the roof trusses, and in a number of cases this distance equals 100 ft. The trusses are usually supported by the side walls which carry the weight of the roof structure and roof. At Topeka the steel skeleton is entirely independent and the roof structure is carried by built-up columns to which the walls are secured to provide stability. The roof trusses span a distance of 100 ft. The elimination of supporting columns and the long span of roofed trusses without intermediate support allow free scope in the distribution of equipment on the floor. The method of handling heavy work in the blacksmith shop by means of swinging jib cranes requires freedom of action for the crane arms and the absence of obstructions facilitates the arrangement of these cranes. The long span of roof trusses, together with the requirement of a stiff frame construction to withstand the additional load imposed by supporting the upper ends of the crane column, calls for heavy parts and careful design of the roof structure. The horizontal loads imposed by the swinging shop cranes requires stiff lateral bracing. While the distance from the floor to roof trusses at some of the older shops is about 20 ft., the height of the more modern shop has been increased to 30 ft.

Almost without exception, the floor of the blacksmith shop is of earth of some kind. This is frequently covered with a

coating of cinders well tamped, and by all means it should be raised 6 in. higher than the level of the ground surrounding the shops.

The ventilation necessary in a blacksmith shop and the amount of natural light needed require a high free space not only to allow the smoke and gas to rise away from the floors and forges, but to permit the diffusion of light from long windows. It is a very noticeable fact that the cleanest, brightest, most airy blacksmith shops are those with high walls. The roof of the blacksmith shop is usually surmounted by a wide monitor extending nearly the entire length of the roof. This is provided for the sake of ventilation rather than to distribute light. The windows in the walls are depended upon principally for natural light, and it is generally considered that the window area should equal at least 60 per cent of the wall area. In order to offer the least obstruction to the free circulation of air throughout the shop in warm weather and in warm climates the windows should be hung on pivots to provide a greater opening than raising and lowering of sashes.

In addition, the shops should be provided with rolling doors and the lay of the shop should be east and west with an open space clear from other buildings on the south side so that all alike will share the south breeze in hot weather. An arrangement frequently followed in the construction of the monitor is to alternate the windows along the sides with space having wooden slats built in on an angle, thus permitting the free circulation of air while excluding rain and snow.

The removal of smoke and gases from the forges is provided for by different methods. Experience in some shops where great care was used in their design to provide for efficient ventilation is said to have proved that smoke hoods in high shops are unnecessary and that the interior of the building is clear and free from smoke and gas at all times.

Hand forges are usually arranged in a row along the wall conveniently placed according to the class of work which they serve. The distance between centers of forges varies from 16 to 20 ft. and 5 ft. from the wall. Forges are arranged at a uniform height of about 24 in. and should be of uniform shape and size.

Careful provisions for tool racks is a necessary detail not to be overlooked, for the care and maintenance of tools and equipment is the duty of the energetic foreman. Tool racks are generally arranged along the wall of the shop and in the center of the shop. For hammer tools, etc., a revolving cone shape tool rack may be provided.

Oil is the most common fuel used in blacksmith shop furnaces. In latter years it has rapidly displaced coal and coke, not only proving more satisfactory and economical as fuel, but also improving the appearance of the shop by removing the necessity of the unsightly coal and coke boxes about the shop. It has been demonstrated by practice that with oil as fuel it is possible to obtain a larger output, a better grade of work by the greater intensity of heat as well as more even heat, the elimination of the necessity of attending the fires, the shortening of the time required to bring the furnace to the desired working temperature and improvements in the conditions under which furnace men work. It is a noticeable fact that in a majority of the new shops particular attention has been paid to the furnace equipment, the design of the furnaces for the various machines and their location in relation to the machine and the movement of the material.

The location of large scrap furnaces should be on the outside of the shop with the working side of the furnace flush with the inside of the main wall. To avoid any possible shortage of steam, boilers should be installed over all large scrap and forging furnaces. By this plan no fuel expense is chargeable to producing steam as the flame and gas from the furnaces do the work.

In arranging the fire and furnaces, they should be so placed that the men are not too near a furnace or fire when working on the metal. Efficiency engineers will figure on the number of steps that can be saved in handling from the fire or furnace to the hammer, or anvil, overlooking entirely the comfort of the men whose vitality is sapped by having the fires too close to the anvil or hammer. The arrangement of furnaces, anvils, hammers and machines should be left to the judgment of a practical man, one who is acquainted with shop practice and who is in charge of smith shops.

No part of the general railroad repair plant has undergone a greater change during the past 10 or 15 years than the blacksmith shop. A few years ago the majority of work passing through that shop was done on open fires and a large quantity of the new material was purchased from manufacturing concerns; today, due to the introduction of forging machines, the majority of work in the modern shop is, or should be, machine work.

Modern machines without proper die equipment are of little value. The main blacksmith shop should be provided with its own tool room where the die work could be carried along independent of the locomotive department, thus avoiding delays. Little attention is given by other departments in assisting foremen blacksmiths along these lines. The following equipment is sufficient for the average shop: one each, planer, shaper, lathe, drill press and face plate. This equipment is installed in the blacksmith shop tool room at Topeka, and greatly facilitates the work of getting out dies for the blacksmith shop.

In connection with furnace equipment and open fires, particular attention should be paid to the layout of blast piping. Efficient blast is a very important consideration to the blacksmith shop as it practically governs the heating capacity not only of furnaces but of the open fires. The blast line should be overhead and the safety valves should be provided in the up and down line leading to the forges to take care of any gas that may possibly enter the blast line.

The main blast line should be reduced in area in proportion to the distance covered so as to maintain a good pressure at the end of the line. When compressed air is used in addition to the blast to atomize fuel oil an eight ounce blast is sufficient. When fan blast alone is used nothing short of ten ounces will give satisfactory results. The exhaust pipes on steam hammers should pass downward through an independent pipe suitable to carry the exhaust beyond the shop into a catch basin.

The modern shop may have all the facilities it is possible to provide and still not get results. The foreman in charge must have the good will and hearty co-operation of each and every man under him to reach the maximum of efficiency.

DISCUSSION

The ideas presented in Mr. Fraser's paper were endorsed by the members who agreed that the arrangement outlined was practically ideal. W. J. Mayer (M. C.) questioned the advisability of restricting the exhaust from the steam hammers, and asked whether any plants used the exhaust for heating. Several plans for using the steam were described. In some cases a butterfly valve is used in the exhaust steam line to limit the pressure. At the West Albany shop of the New York Central the exhaust from the hammers is piped to the heating system and no heat is required in any part of the plant other than that furnished by the exhaust steam. A similar arrangement is used on the St. Louis-San Francisco at Springfield, Mo. The advantage of piping the exhaust down to prevent condensation injuring the packing and dripping on the dies was brought out by several who spoke.

RECLAIMING SCRAP IN THE RAILROAD SHOP

BY WALTER CONSTANCE
St. L. & S. F.

Although the subject of the paper I am to present includes scrap reclaiming by the use of oxy-acetylene and electric cutting and welding process, electric welding is not in use at our reclamation plant, and I will have to leave the discussion of electric welding in relation to reclamation to others.

We use the oxy-acetylene torch in stripping frogs, switches, etc. We save good filler blocks, reinforcement and similar parts to use again. We furnish over 50 per cent of all switch material used on the system. Switch frogs, switch stands, switch rods and plates are reclaimed or repaired. Brace or slide plates are made from old Weber joints and scrap boiler steel, also transit clips for switch points from scrap steel.

We have also made up quite a number of oil tanks from tank cars which have been burned. These are cut up by the torch and the best of the steel is sent to the boiler shops for use. The rest is cut up under shears to make switch material and repair parts for steel frame cars. Old cisterns for locomotive tenders are cut up and used to make loading platform running boards, and coal car corner bands. Good parts of scrap steel cars are used for the same purpose. Some of our brake beam stripping is done by the oxy-acetylene torch.

We formerly welded quite a number of bolsters and baggage wagons and warehouse trucks. Oxy-acetylene welding comes in handy on these things, especially for repairing steel warehouse trucks, the frames of which are broken, as it does not pay to repair them in the blacksmith shop when they have to be stripped, but by oxy-acetylene welding they can be made serviceable again at small cost without stripping them.

We formerly welded quite a number of bolsters and truck frames as well as broken couplers at this plant, but of course we have discontinued doing so now. However, we are changing a large number of good couplers with 5 in. by 5 in. shank, 6½ in. butt, to 5 in. by 7 in. shank and 9⅛ in. butt. This is done by welding tapered slabs of steel on the shanks and blocks upon the butts. These then conform to M. C. B. dimensions.

We also reclaim a number of derailing frogs, which are for smaller rails than our standard 90-lb. by splitting them and inserting a piece in the side and welding up with oxy-acetylene so as to bring them to the proper height for the larger rail.

There are no rolls at our plant, but all second-hand bolts are used by cutting off and re-threading, and nuts by re-tapping. Also all flat iron and round bars are saved for use. Bottom rods are made with solid jaws from old 1½-in. A. C. rods, dump rods, and so on. Truss rods 1¼ in. in diameter are made into brake stuff. The short pieces left over are made into brake beam truss rods, bolts and coupler rivets. Other sizes of rounds are used for handholds, bolts, etc. Rusty ¾ in. and ⅞ in. steel is rolled into brake shoe keys on an abandoned spring roll. Rusty and pitted rounds 1⅛ in., 1¼ in. and 1⅜ in. are made into grade stakes for the engineering department. All limed iron is rattled and made into frog bolts and switch chain links. We make standard 1 3/32-in. brake pins by upsetting one-inch iron on the forging machine.

All brake beam repairing on the system is done at this plant. We use an air bulldozer for straightening. All beams are stripped by laborers, and are re-assembled by blacksmiths and helpers.

All round iron and bolts are straightened under air hammers at the scrap docks. The bolts are sheared to length and sent to the threader and the iron is sheared for heading in the blacksmith shop. All serviceable track spikes are also straightened at the yard shop.

Coil springs that are standard are reset. Scrap springs are uncoiled on a special machine and made into lining bars, jack bars, rock drills and drift pins.

All track tools on the system are sent here for repairs. Worn claw bars are made into engine pinch bars and lining bars. Picks are welded if they have one end long enough to sharpen. Where both ends are to be welded it does not pay to repair them. Short picks are heated and cut off to obtain steel for welding out others. We also make new claw bars, lining bars and tamping bars from scrap tire steel. All blacksmith's tools are made from tire steel and we also use tire steel for the manufacture of bolt dies and hammer tools.

Crooked angle bars for small sized rails are straightened in tools under the steam hammer. This tool spreads the bars slightly and makes them serviceable for siding and commercial tracks.

All coupler yokes are stripped at this plant under a power shear. Yokes are repaired when possible and scrap yokes are used to obtain iron for the forging furnace.

Brake levers that are not standard are re-punched, cold plugged and returned to service. Old sill steps are used to make running board brackets, pipe clamps, etc. All car material, such as brake rods, brake hangers, brake staffs and fulcrums which are repairable are sorted at the scrap docks and repaired in the blacksmith shop.

A very close check is kept on the costs, and if a good margin of profit is not shown we do not attempt to repair and reclaim. The welding and cutting apparatus is here to stay because we make a specialty of repairing or reclaiming, whereas that is only a side line in ordinary shops and naturally not so successful.

DISCUSSION

C. E. Stone (D., L. & W.) told of the good results secured by re-rolling scrap bars. G. Fraser (A., T. & S. F.) brought out the advantages of reclaiming as much material as possible at the shop where it originates. He also called attention to the necessity for careful consideration of the work done in order to avoid reclaiming where it is more expensive than the purchase of new material.

HEAT-TREATING

BY H. E. GAMBLE
Pennsylvania

Of late years there has been a marked advancement in the art of heat-treating parts incidental to locomotive and car construction and maintenance. In making the forgings, the billets are cold throughout before being heated to the forging temperature. The finishing temperature, the rate of heat advancement and the capacity of the hammer used are of great importance in forging the different parts. After forging, the parts are first thoroughly annealed to relieve the strains set up in forging. They are then heated and quenched in oil or water. From there they are placed in the drawing back furnace, where they are tempered. The steel used in making these forgings is covered by specifications which call for a carbon content of from .40 per cent to .55 per cent. The quenching and drawing back temperatures are governed by the per cent of carbon contained in the steel. The physical requirements of the heat-treated forgings are determined by the specified diameter or thickness which governs the size of the prolongation from which the test specimen is secured. It should be taken at a point midway between the center and outside of the forging in the direction in which the metal is most drawn out in the forging process.

Each forging must have the manufacturer's mark, melt number and year in which made stamped on as a means of

following up the treatment in case of failure in service. It is most important to give all forgings a thorough annealing to relieve the strains set up during the forging operations to insure a good treatment. Furnaces properly charged and forgings heated thoroughly will give the best results. We are reclaiming all main and side rods that are free from fractures, that have been bent, twisted, upset and stretched while in service, thus doing our bit to help the repairing of locomotives along by saving steel, time and labor. These rods are made correct to a template by the blacksmith, allowing for the proper shrinkage. They are then taken to our heat-treating plant, giving them the proper annealing, quench heating, quenching and drawing back. They are then returned to the blacksmith for final inspection and are then ready for service. In reclaiming rods for service, it is necessary to have blacksmiths who are interested and careful in their heating and workmanship. The reclamation, reforming and subsequent heat-treating of many parts which heretofore were scrapped, is one item that will pay the entire cost of heat-treatment alone, not to mention the saving effected along other lines.

POWDERED COAL FOR FURNACE HEATING IN SMITH SHOP

BY H. E. GAMBLE

In handling producer gas and oil furnaces for forging heavy locomotive parts, drop forging, heat-treating and bolt making, the question arises whether a change to powdered coal would be warranted on account of the low cost in operating. In connection with experiments on mixing crude oil with powdered coal, this might help to use up heavy grades of fuel oil coming into the markets for heating purposes. Coal in a finely divided or powdered state represents the most advanced method for producing perfect combustion, making it possible to more nearly obtain the full heat value of the fuel than by any other known means. The generally recognized waste, unstaple or otherwise low-value coal mine products are suitable for converting into the powdered form. To give the best results as regards complete combustion and the least trouble as regards ash and slag, it is very necessary to have powdered fuel dry and keep approximately 48 hours' supply on hand to prevent the possibility of the coal absorbing too much moisture. The statement has been made that it is not necessary to build new furnaces, as by a slight change present equipment can be made to handle powdered coal. Coal rich in volatile matter is preferred, slack or screenings in preference to run of mine. To successfully burn powdered coal, it should be uniformly fine. The maintenance of a correct ratio of air to coal is absolutely necessary, as on this depends the ability to hold an unwavering and uniform temperature in the furnace, which ranges up to 2,200 deg. F.

We have unquestionably passed through one of the greatest fuel conservation periods known, and the members of this association should do all in their power to secure the best equipment and use their good judgment in conserving all fuel possible in running the blacksmith shops.

OTHER BUSINESS

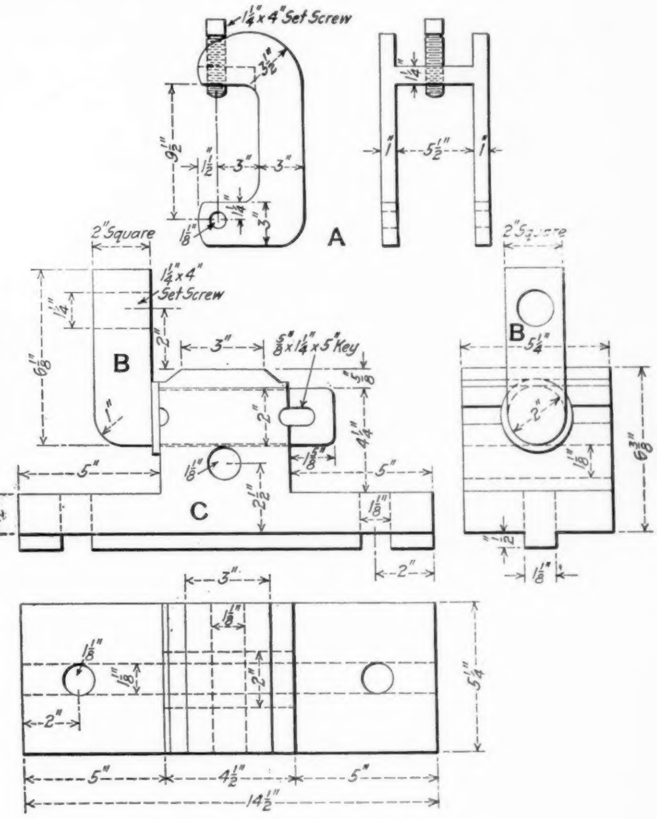
The report of the secretary-treasurer showed a total membership of 375 and a balance of $741 in the treasury. A committee was appointed to confer with the officers of the American Railroad Association regarding amalgamation with Section III, Mechanical.

The following officers were elected: President, J. Carruthers (D., M. & N.); first vice-president, W. J. Mayer (M. C.); second vice-president, Joseph Grine (N. Y. C.); secretary-treasurer, A. L. Woodworth (B. & O.). In the balloting for the location of the next convention Birmingham, Ala., received the largest number of votes.

A TIRE CLAMP FOR BORING MILLS

BY H. L. LINGO

A clamp for a boring mill, so designed as to permit the boring and turning of a tire at one setting, is shown in the drawing. A complete set consists of four of these clamps; all of the parts shown and the necessary keys and set screws are made of steel. To set up a tire on the mill ready for boring, the blocks *C* are secured to the table at the proper points for the diameter of the tire to be bored. The tire is placed on the blocks and the clamps *B* inserted through the block, on the outside of the tire, and then keyed in position through the slot shown in the drawing. A 1¼-in. set screw in the square portion of each of the clamps *B* provides a



Details of the Block and Clamps

means of securing the tire firmly and accurately in place. When the boring is finished the clamps *A* are placed over the blocks *C* so that the 1⅛-in. holes in the clamp coincide with cross-wise holes in the block, and a pin or key is inserted. The upper portion of the clamps *A* are directly over the tire and the 1¼-in. set screws are tightened against the tire, holding it firmly to the block. The clamps *B* are then removed and the tire being secured by the clamps *A*, may be turned without resetting.

This method is very useful in a shop turning out extra tires of varying diameters and tread thicknesses for replacement of worn tires at other points on the road, and can also be used with equally good results in turning new tires.

THE LUMBER FREIGHT BILL.—The annual freight bill of the lumber industry is estimated at about $215,000,000. Lumber and forest products furnish about 11 per cent of the total tonnage of the American railroads or about 215,000,000 tons yearly, according to Interstate Commerce Commission statistics. This is greater than the movement of all agricultural products and is exceeded only by the tonnage of general manufacturers and mine products.

British Army Locomotive Repairs

Story of the Military Shops Near Rouen, France, Equipped and Operated by the Royal Engineers

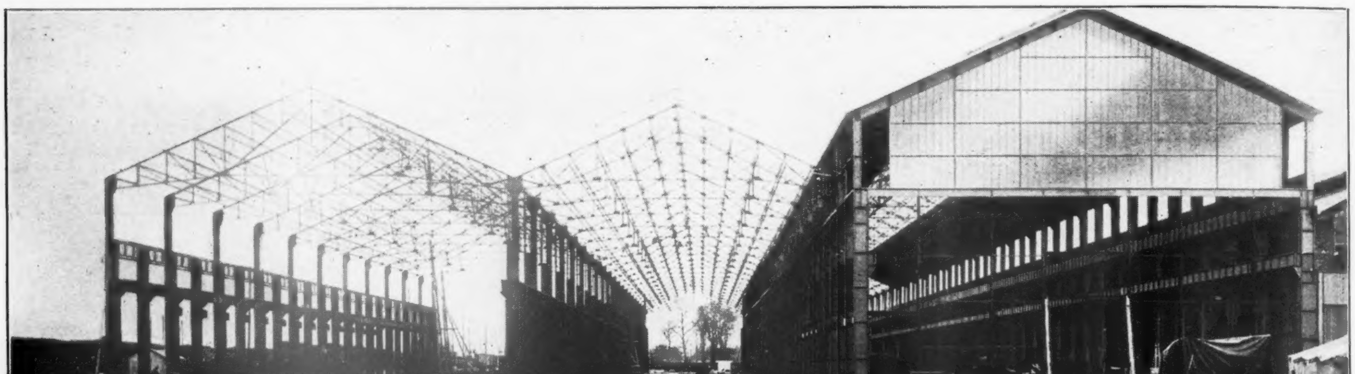
BY H. L. COLE
Lieutenant Colonel, R. E.

THE shops shown herewith in various stages of their construction and equipment were used by the British Transportation Service for locomotive repairs during the last two years of the war.

The project is located near Rouen and was commenced by the French State Railway in 1912, but only partially erected when, in 1914, war broke out and interrupted the work.

Near the main shops, but outside the main shop yard, the Royal Engineers built and equipped a pattern shop and brass and iron foundries, which turned out castings as large as locomotive cylinders on occasions, but normally supplied all common renewals requisite for locomotive casualties and fair repairs.

The corrugated cupola shown in one of the photographs



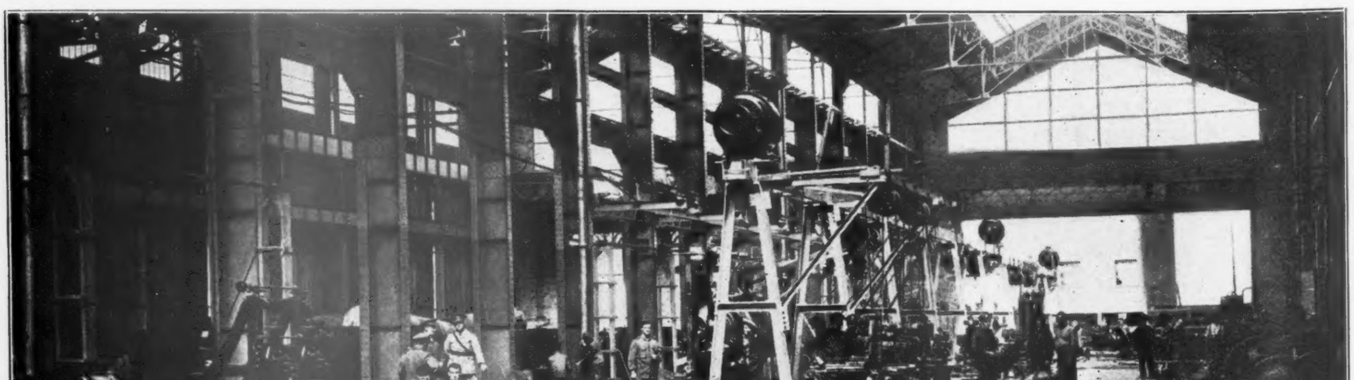
British Expeditionary Force Base Locomotive Repair Shops Near Rouen, France, As They Appeared in March, 1917; the Erection of the Outside Bay on the Left Was Started in February, 1917

By arrangement with the French, the British Royal Engineers, Transportation Branch, took over the uncompleted shops in February, 1917, finished and equipped them, and continued to use them for the repair of the British, American, Canadian and Belgian standard gage locomotives in use by the British Expeditionary Force, until after the armistice was signed.

Within half a mile of the shops the sappers built their

was improvised out of a collapsed Fox corrugated furnace, bought as scrap-iron from a French junk-shop and rushed up to increase much needed output at a time of stress. Another was added later. Each gave approximately two (British) tons an hour, with a coke consumption between 4 and 5 cwts. per ton of fettled castings.

To appreciate the actual output of erected and repaired



Erecting Shop, Partly Completed, in August, 1917, With Canadian Built Locomotives in Course of Erection; Cranes of Eight Tons Capacity are Shown on the Lower Runway, Heavy Cranes Not Being Installed On the Upper Runway till February, 1918

standing camp, the living huts being 16-ft. by 66-ft. demountable structures, to a standard and very economical design. A large proportion of the camp was built of packing-case timber, stripped off imported locomotive parts and run through an improvised saw mill on the site.

locomotives, it should perhaps be mentioned that the scheme was only mooted in December, 1916. On December 18 the first officer was appointed, on the 19th the site was inspected; on Christmas Day, the machine tool and equipment estimates were put up for approval and detailed lay-out plans were in

hand. However, it was not till February, 1917, that the first small draft could commence work on the site, and the machinery and equipment arrived but slowly.

Both camp and works were built and fitted up by the men who had to use them. These were skilled men of all the necessary locomotive workshop trades. Half of the officers and men had fought in the front line, over a hundred had been through the Mons retreat or later operations entitling them to the 1914 Star and very many carried wound stripes. There were officers and men from India, China, South Africa, South America and Australia; and numbers of others who had never been outside the Old Country before the war. There was nothing of trades union restriction about these men. Machinists, blacksmiths, boilermakers, pattern-makers or moulders, dug and mixed concrete for foundations, built huts, erected shops, rigged derricks or did the next job that had to be done, whatever it might be.

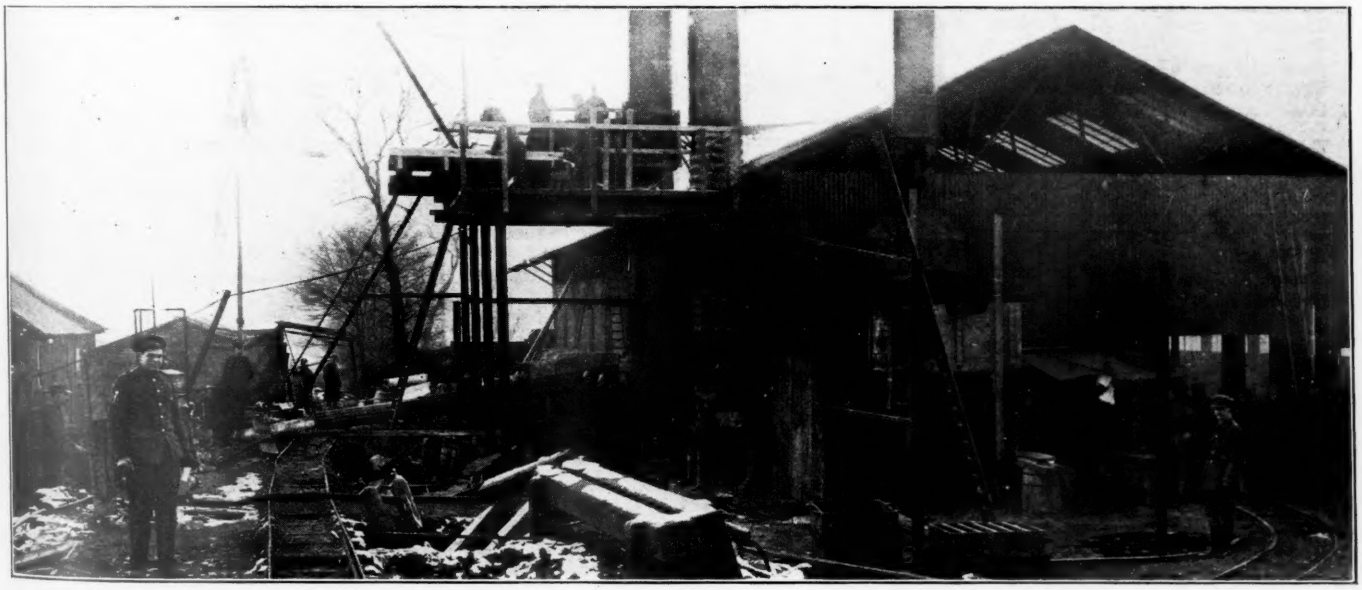
The erection of engines imported from Canada and the United States was commenced almost as soon as the machine tool equipment began to arrive and months before the cranes were up, and proceeded simultaneously with the building and internal preparation of the shops. The first two engines were turned out together early in July, 1917.

The power plant, ordered in March, 1917, was placed in operation on October 4, 1917; but prior to that several machines were got going with temporary drives from small internal combustion engines. Over 30 (British) tons of iron castings were produced in a small emergency foundry before the power-house was working. The fan was driven at one time by a jacked-up Ford car, but mostly by a venerable portable steam engine, salvaged from a scrap-heap.

By the end of 1917, however, the establishment was up to strength and the shops almost in full swing. There had been 135 locomotives erected and a start had been made with heavy—some very heavy—repairs.

Machine Shop During Installation of Machine Tools, September, 1917

Up to the end of December, 1918, 232 new locomotives were erected and 370 engines were repaired, 2,073 pairs of wheels were turned up and 275 wheels re-tired, 737 tons of forgings were turned out, 2,186 tons of iron castings and 168 tons of brass. The average output for 1918 is shown in the table.



The Foundry as it Appeared in December, 1917; Note the Cupola Built Out of a Corrugated Furnace

Throughout the operation of the shops the work was gravely handicapped by the extraordinary variety of engines to be dealt with, the exceptionally bad condition of many that had worked for years without a good repair, the paucity of working drawings and the impossibility of either obtaining or

maintaining good stocks of spares, or of getting them rapidly from England or America. Not the least of the handicaps were the natural corollaries to war conditions; an abnormally high proportion of serious defects due to rough track, rough handling and rough working conditions. For example, of the first 300 engines repaired, 15 had burnt fireboxes. One engine, a six-coupled inside cylinder type, arrived with her boiler-barrel pierced clean through and her motions wrecked by an aerial bomb. Cracked cylinders, bent and cracked frames, and chewed-up front or trailing ends due to collisions or other roadside adventures flowed in erratically, at times, especially during the great German effort in March-April, 1918, in abnormally high proportions.

during 1918 was 30 days per engine, including trial. The average man-hours expended per engine, excluding spares

AVERAGE OUTPUT OF BRITISH ARMY LOCOMOTIVE REPAIR SHOPS NEAR ROUEN IN 1918

	Number per week
Engines repaired	7
Wheels turned up, pairs	38.4
Wheels re-tired	5.4
Forgings, tons	12.8
Iron castings, tons	37.9
Brass castings, tons	2.8

drawn from stock, amounted to 3,418 for engine and boiler (including 655 for boilermakers) and 643 for the tender; total, 4,061 man-hours per engine complete for the road. The figures cover direct charges only and do not include time required for patterns and castings.

ROUTING SCHEDULE

ENGINE NO. CLASS REPAIR CLASSIFICATION

OPERATION (ERECTING SHOP)	Date routed	Actl date
Engine in shop, stripping begun		
Off wheels, wheels to wheel shop		
All parts delivered to Bosh.		
Boxes back to engine for gages		
Final inspection and orders		
Boiler out		
Cylinders off, S		
Stripping completed		
EX STORES AND BLACK SHOPS		
Cylinders (from stock) to E.S.		
Hornblocks, clips, wedges		
Slidebars		
Axleboxes and details		
Crossheads, slippers & gudgeon pins		
Pistons, rods and details		
Motion and reverse gear details		
Brake cylinders and details		
Boiler mountings		
Vacuum, steam or air brake details		
Valves, spindles and fittings		
Connecting rod details		
Spring gear		
Piston and valve glands and packing		
Brake gear		
Sanding gear		
Frame details (buffer, couplings,etc.)		
Smokebox steam and blast pipes		
Coupling rod details		
Cab details		
EX FITTING SHOP TO ERECTING SHOP		
Hornblocks, clips and wedges		
Slidebars		
Axleboxes and fittings		
Crossheads, slippers & gudgeon pins		
Pistons, rods and details		
Wheels		
Motion and reverse gear		
Brake cylinders and details		
Boiler mountings		
Air, vacuum or steam brake fittings		
Springs and gear		
Brake gear		
Piston and valve glands and packing		

EX FITTING SHOP TO ERECTING SHOP	Date routed	Actl date
Valves, spindles and fittings		
Sanding gear details		
Smokebox steam and blast pipes		
Coupling rods		
Frame details (buffers, couplings,etc.)		
Connecting rods		
Cab details		
OPERATION (ERECTING SHOP)		
New cylinders bolted to frame		
Boiler in (ex stock)		
Lines up		
Slidebars up		
Hornblocks faced		
Crossheads and slippers fitted		
Pistons in		
Axleboxes fitted to frames		
Reversing gear up		
Motion hung		
Brake cylinders up		
Buffer beam on		
Boiler clothing fitted		
Axleboxes fitted to wheels		
Springs and gear up		
Engine wheeled		
Motion up		
Brake gear up		
Coupling rods up		
Boiler mountings		
Steam, vacuum or air brake ftgs. up		
Valves fitted		
Off pit		
Connecting rods up		
Sandboxes and gear up		
Valves set		
Tender finished		
Smokebox finished		
Pipes finished		
Cab platforms and frame ftgs.finished		
Tender coupled		
Steam and brake test		
Trial trip		

Type of Locomotive Repair Schedule Used in British Military Shops Near Rouen, France, for Heavy Repairs, Including Renewal of Cylinders and Boiler for Outside Cylinder Type Locomotive

The spirit and discipline of the men were well shown when, instead of being told that the strain could be eased off after the armistice, they were called upon to slam into their work again for all they were worth, in order to cope with the increased strain necessarily thrown on the transportation services due to the general advance of the Allied armies. Their average out-turn of repaired engines per week from the date of the signing of the armistice till December 31, 1918, was 8.8.

The average time the engines were detained in the shops

A planning department was maintained and the work was scheduled and routed through the shops. Several forms were used for routing, to suit the different types of locomotives handled and the different classes of repairs. A typical form, for heavy repairs to a locomotive with outside cylinders and valve chests, including renewal of boiler and cylinders, is shown in one of the cuts.

Reasons for Excessive Labor Turnover

Experiences of a Former Railroad Mechanic on Going Back Into That Work in a Western City

BY "NEWT"

It is a well established fact that there are two great wastes in industry today; one the lack of efficiency in management and the other the labor turnover.

After being away from railroad shop work for almost eight years, circumstances recently compelled me to seek work in this field. Being in a certain western city where my acquaintances were few, it was necessary for me to apply for work as machinist in a railroad shop. In view of the wonderful strides made along efficiency lines in many other classes of work, I naturally expected to find many new and better methods, especially for running repair work on locomotives. If the roundhouse I worked in is typical of the methods more generally used, then there has been little change for the better and certainly there is room for great improvement.

THE QUESTION OF PHYSICAL EXAMINATIONS

The first thing that struck me was the objection on the part of the employees to the physical examination, and yet I could see that this is a small but rather important matter as concerns labor turnover. Very few men give good excuses for objecting to it, except that it interferes to a certain extent with their personal liberty. One criticism is that the company requires it and yet compels the men to pay for it. The general opinion advanced by the employees is that if the corporation wants this examination it should pay for it, as it is really no concern of the employee. Another and vital criticism is that after taking the examination, no precautions are taken by the corporation to protect the men in a sanitary way. My own experiences will bear this out, as far as this particular shop is concerned, and to my knowledge many others are just as bad. It is a fact that few men are turned down for shop work on their physical examination.

SANITARY CONDITIONS DISGUSTING

After taking a somewhat severe examination I naturally expected that sanitary conditions would be about right in the shop. What was my surprise after the first day's work was completed, to be compelled to wash in a hog trough—a real community trough—which is filled with water and steam heat applied; then as many as 50 men wash in the same water. After three days my face broke out in sores and kept getting worse each day until I finally came to my senses and found a boiler wash lead pipe, where I could wash in cold water with the added pleasure of having my feet get a bath. Should not the doctor in addition to making the physical examination go far enough to see that sanitary conditions are good? Evidently he does nothing of the kind and his work ends just where it really should begin. The general opinion around that "trough" was, "what a farce the physical examination was when such a condition was allowed to exist."

I learned that the matter had been up to the local manager several times and many promises had been made, but the abuse still remained. Is it any wonder men combine to take such matters up with the management? Good men will not stay long in such a place. At a small cost the corporation could install a sanitary washing system which would do away with this cause of dissatisfaction and the resulting improvement in the labor turnover would soon pay for the investment. The engineers and firemen at this particular point were provided with good washing facilities within plain sight of the "hog trough," but the shop men were denied its use. This was rank discrimination and the other workmen did not fail to express themselves concerning it. I am sure a great many objections to the physical examination would be removed if some thought were given to the question of sanitation.

There were 20,000 deaths in this community from influenza; while this wash trough was not the cause of all this trouble, who can deny that it must have been a wonderful agency in helping spread the disease? Who would have gained most if sanitary washing places had been provided for the shopmen?

Is "Newt" Right?

"Newt," in his discussion of the labor turnover problem, scores the railroad in question for miserably inefficient methods and practices.

Is this case an isolated or unusual one? It reads almost like a chapter from the Dark Ages. Certainly the conditions are below the standards which exist on most roads.

Cities have been greatly beautified and improved by the publication of photographs showing examples of filth and untidiness. We shall welcome "pen pictures" from our readers of inefficient and unsanitary conditions which come under their observation on railroads with which they are familiar.

What is the underlying cause of the condition described by "Newt?" In the final analysis who is really responsible for it?

TOOLS ARE REQUIRED FOR GOOD WORK

Another very strong factor in the labor turnover is the reception a new man usually gets. After reporting for work the first morning I was turned over to an old man, who was supposed to equip me with the necessary tools to work with. It was soon apparent that his only interest was to give out just such tools as he had on hand; he could give no idea as to when the remaining tools, if there were to be any, would be forthcoming. The tools I was furnished with were a monkey wrench, two chisels and a hammer; except for files, this was my entire equipment during the whole time I remained.

No attempt was made on the part of the foreman to acquaint a new man as to how the tools or supplies could be reached. He had no time to attend to such details. As no specialty men were allowed in the shop, mechanics had to do all sorts of work. A man had to hunt a new set of tools for each new kind of work, and he might have a dozen different kinds of work in the day's run. There were two tool rooms or two places where tools were kept; just why I could not understand and the result was that a new man often found himself at the wrong tool room and was compelled to retrace his steps to the other. The result was that a new man was of very little use for the first two or three weeks because of this fact.

One of the tool rooms was presided over by the old man

who provided the new man with his tools, as mentioned above; I have seen three and four men stand for 30 minutes waiting for his return from some (very important in his imagination) errand. The only reason I could see for the two tool rooms was to provide this old employee with work. It seems to me he could have been placed where he would have done less harm or else have been pensioned as was suggested by many who had to contend with this vexation.

MATERIAL MIGHTY SCARCE

Another thing that has a very direct bearing on labor turnover, and one that is not given a great deal of thought in many places, is the method of material deliveries to the men who have the real work to do. To make this more clear I will outline some of my experiences. The first thing that was necessary when wanting materials from the storehouse was to go to the office and get an order. This was placed in a box, where it was picked up by the stores department and the materials were then delivered to a box located in the roundhouse. I was given a couple of front end main rod brasses to reduce; before starting the work I ordered a half-round file with which to do the work, thinking it would surely be delivered by the time it should be needed. When ready for the file, I went to the delivery box and it was not there, this being about one and one-half hours after starting the work. After going to two or three machinists in an endeavor to borrow one, I finally managed to find an old worn out file and to get the work done in time to prevent any delay in the movement of the engine to the train. The new half round file was delivered 24 hours later. Good fortune played into my hands in this respect, for I happened to be going by the delivery box at the time the file was delivered; otherwise it would have found its way into some other man's equipment. Why was the stores department so long in making this delivery, or if it was short on this item why was there no advice as to non-delivery, in view of the fact that the order had been O.K.'d by the proper party?

Some may say this was an isolated case, but to show what a farce this delivery actually was I will recite some other experiences. A few hours later it was necessary for me to order some small bolts for a drop pit engine and being in no hurry I thought I would see how long it would take to get the material. After placing the order in the usual manner I waited until the next morning before going to delivery box. Not finding the bolts I had another order placed and again waited. After going to the box the third morning I went to the clerk and explained the circumstances and after phoning the stores department the third order was placed and then came the delivery. Before I had time to reach the box more than half the bolts had been taken. You can readily see how much time was wasted on such a small matter. Upon asking some of the older men what they did when they wanted materials in a hurry I was told there were some scrap cars about 1000 feet from the house and that they usually went there and after searching managed to find something for a makeshift.

My contention is that the materials should be delivered promptly or the mechanical department notified at once so that provision may be made for some method of getting the material without a high priced mechanic spending his time hunting in the scrap pile. There seemed to be no co-operation between the mechanical and stores department as far as efficient delivery of materials was concerned.

INADEQUATE SUPERVISION

Another feature that has a very direct bearing on the labor turnover is the manner in which the work was supervised. The organization at this particular place consisted of one assistant master mechanic, general roundhouse foreman, roundhouse foreman and assistant roundhouse foreman. The assistant roundhouse foreman, as far as I could see, did most of the work, his duties consisting of taking all the work off the engineers' reports, distributing this work, as well as all the inside and outside inspectors gave him, handling the engines on the drop pit, and handling the machine shop where the roundhouse work was mostly done; this shop was one hundred feet from the house and on the opposite side from the office. He also kept 48 machinists busy. The general roundhouse foreman made a trip or two a day through the house and the roundhouse foreman spent most of his time at the turntable; indeed I have often seen him taking a turn at running the table.

Much has been written about keeping the number of men handled by any one man down to 30, but here was a man handling at least 75 men in addition to all the other duties mentioned. If that man had been burdened with less duties he could have given more time to seeing that the men were properly supplied with tools and have given more direct supervision to their work.

KEEPING DOWN THE LABOR TURNOVER

I would suggest some of the following things to help keep down the labor turnover:

Matters Causing Dissatisfaction.—Intelligent consideration should be given to the complaints from individuals rather than to let them reach a stage where some labor organization can make them a grievance. After the medical examination is given see that proper sanitary measures are taken to safeguard the employees, especially in providing suitable places for washing and for the men to hang their clothes. It was three weeks after I went to work before I was provided with a place to hang my clothes. When I spoke to the general foreman about it I was informed that there would be more cupboards next day, but they had not arrived when I left the service. This is a matter entirely up to the local manager and proper thought and consideration on his part would easily have removed this cause for dissatisfaction.

Lack of Proper and Sufficient Tools.—Every man should be equipped with a full complement of small tools to keep the trips to the tool room down to the minimum. Proper checking of the tools a man has when he begins and leaves the service would go a long ways in keeping down the loss of them and more than pay for the money invested. Many railroads think that giving a man small tools that should be carried (in their estimation) in the tool room is a distinct loss, but after being around a shipyard and seeing the methods used there in this respect, I am sure much time would be saved, and money too, if all mechanics were properly equipped with small tools. In the shipyards it takes about one and one-half hours to get a clearance and most of this time is spent in "squaring up" with the tool room. If the railroad shop spent half this time checking a man in and out what a saving it would be.

Proper Supervision.—This question is rather a hard one to solve, but its relation to the labor turnover is very intimate. The man who is kept reasonably busy by a foreman who knows how to get the work out of his men is a much better contented and a more reasonable man. Indifferent care in this respect forces good men to move. Wages have reached such a high level that a reasonable amount of attention to the above details will go a long way in stopping the turnover, which is a big factor in helping to make railroad shop costs soar skyward.

CAR SHORTAGE LIKELY IN FALL.—A statement has been authorized by the Southern regional director's office to the effect that only the most careful handling of cars by the railroads with consistent and wholehearted co-operation from the shipping public can prevent another shortage of freight cars during the coming fall and winter. It is stated that every piece of equipment is now in use on many lines.

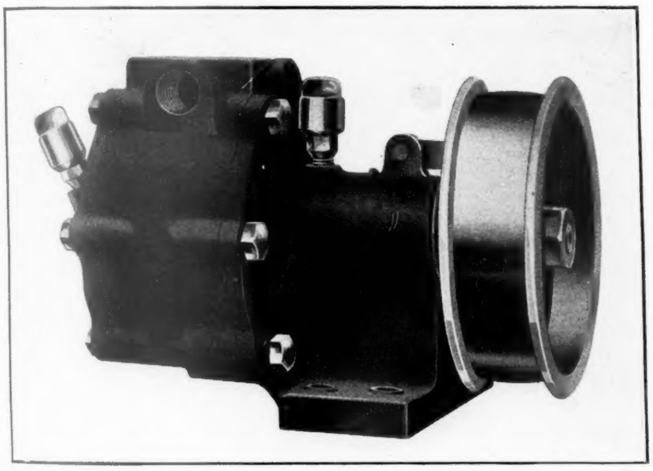
New Devices

THE ROLLWAY PUMP

A new departure in pump design has been developed and placed on the market by the Michigan Machine Company, Detroit, Mich. This pump, known as the Rollway, is especially designed for pumping cutting tool lubricants.

The end sought in designing this pump was the elimination of such trouble as loss of prime, clogging, inadequate suction and short life. These pumps have now been in use for more than a year and have been found to possess these qualities and are said to have shown many other advantages as well.

The illustrations show the simplicity of the pump construction. The principal working parts consist of two rollers which rotate eccentrically in the pump chamber. The entire motion is rolling, thus eliminating all wear which is caused by the scraping of working parts against the pump chamber.



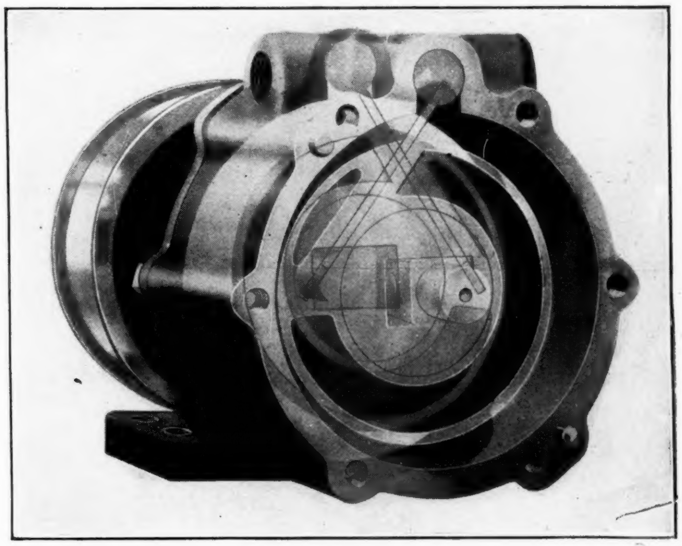
The Rollway Self Priming Pump

The pump is self-priming, may be used anywhere within 10 ft. above the level of the liquid and will prime itself, requiring no valves. This positive suction is not affected by aeration, as is the case with many other pumps. The tank from which the liquid is being pumped may be entirely emptied and the pump allowed to suck air, and when the tank is refilled it will immediately prime and start pumping again. No relief valves or overflow piping are required. The outlet in the discharge piping may be closed and the pump allowed to run without damage to itself or the piping. This result is obtained by the use of a spring placed in the rectangular slot in the inner roller, which bears against the squared shaft. This spring operates only when the pressure on the pump is as great as the pressure required to compress the spring. When this pressure is reached the compression of the spring allows the rollers to come to the center of the pump, where they continue to revolve in the liquid without exerting further pressure on it.

The pump is not affected by foreign matter in the liquid, and will not clog. Any particles, such as cast iron and steel chips, paper, rags, waste, etc., which can pass through the intake pipe will pass through the pump without clogging or damaging it in any way. The action of the pump is to roll the liquid in front of the pump rotor, so that should anything stick, the spring will compress, allowing the roller to pass over the obstacle without damage. The foreign matter will be washed out on the next revolution of the motor.

The pump is universal and may be used with either side up and at any point on a machine where its application is most convenient. Either side of the pump may be used as intake or outlet. Plain pumps may be used on a reversing machine where no liquid is required when the machine is reversing. The pump can be reversed without harming it, and it will deliver liquid again immediately its proper direction of rotation is resumed. A pump equipped with reverse valves is furnished where it is necessary to maintain a constant flow in a given direction regardless of the direction of the rotation of the pulley.

Speed is not a factor in the efficient operation of the Rollway pump. It may be operated at speeds ranging from 100 to 600 r. p. m. or more, making it applicable to all types of machines without the extra expense of making special



Interior of the Rollway Pump

provision for either high or low speeds in order to secure maximum efficiency. The fact that it may be operated at very low speeds insures long life where low speed can be obtained.

The Rollway eliminates the necessity of using numerous sizes and types of pumps in order to obtain maximum efficiency on various types of machines and the necessity of carrying repair parts for different types of pumps. It operates with equal efficiency in pumping either water or oil, and the low horsepower required per gallon of liquid pumped permits a considerable economy in cost of operation.

These pumps are furnished with controlling springs to

develop 25 lb. pressure at 200 r. p. m., or for higher or lower pressures as may be required.

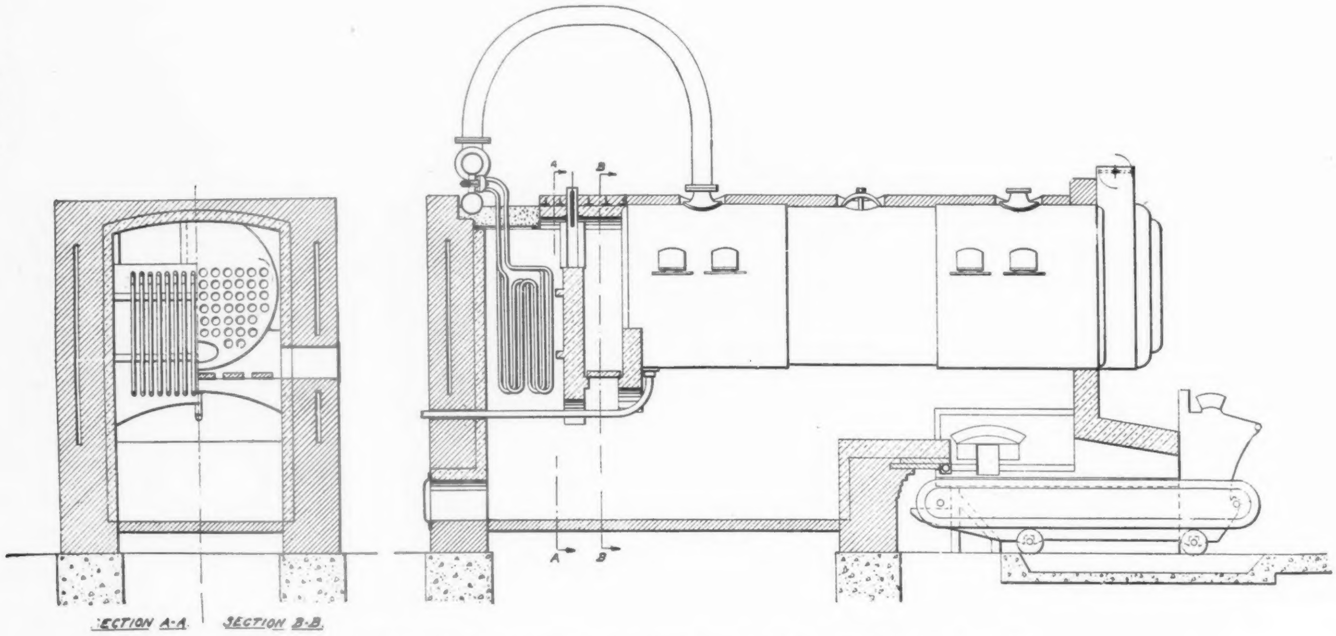
SUPERHEATER FOR STATIONARY BOILERS

An adaptation of the locomotive type of superheater to stationary boilers is being introduced by the Locomotive Superheater Company, New York. This superheater is known as the Elesco.

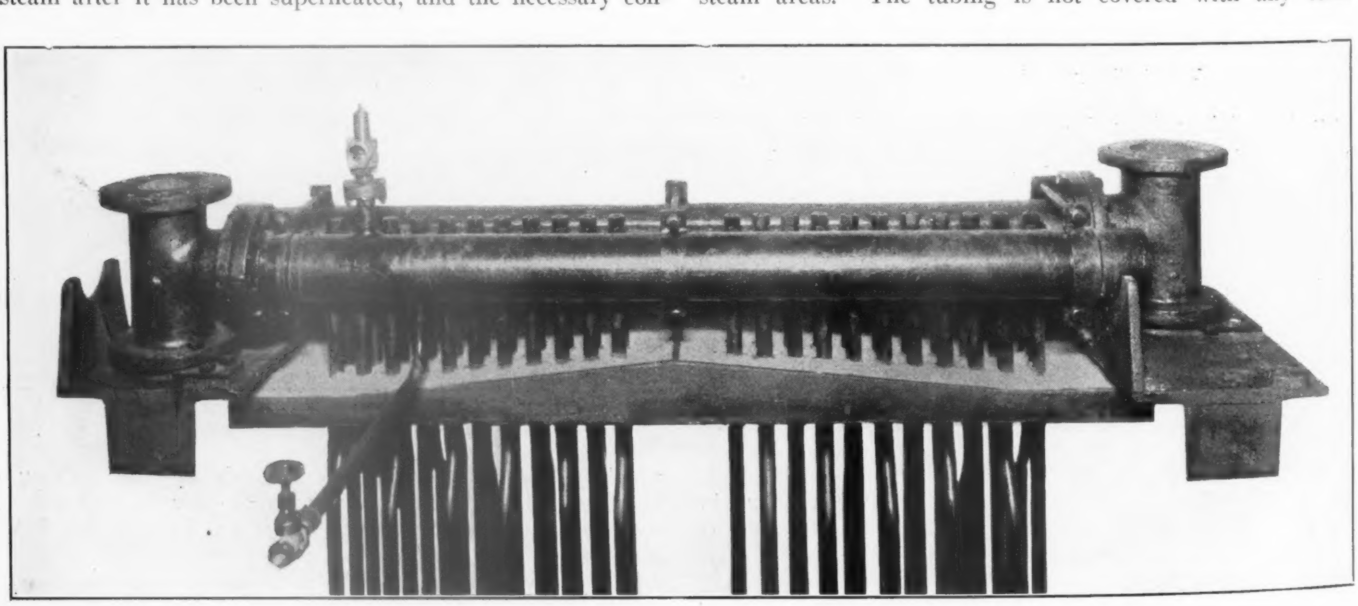
The superheater consists of two headers, one acting as the distributor for the saturated steam coming from the boiler and the other a superheated header for the collection of the steam after it has been superheated, and the necessary connecting units in which the actual superheating takes place. A typical arrangement is shown in the illustration.

The headers are made of steel throughout, are located entirely outside of the hot gas path, and in the majority of the designs, outside of the boiler setting proper, so that the headers as well as the unit joints are accessible for inspection and repairs without entering the boiler setting. The advantage of such an arrangement will readily be appreciated. Safety valves conforming to the A. S. M. E. Boiler Code are provided and are located near the outlet. Provision is also made for drainage and connections for thermometer cups.

In most cases the headers are made with the outlet on the superheated header in an opposite location to the inlet on the saturated header, assuring an even distribution of the steam flow through all units. Where conditions are such as to require it, the saturated header is provided with several inlets.



Elesco Superheater Adapted to a Horizontal Return Tubular Type Boiler

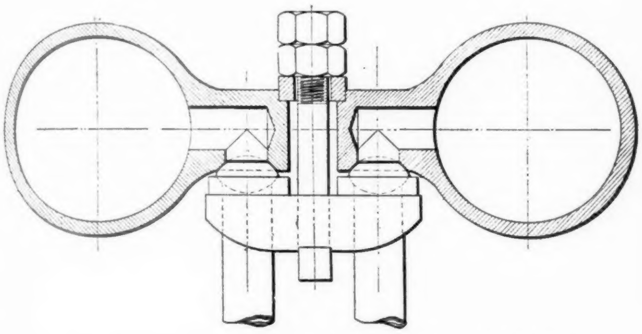


Outside Header Superheater Assembled Ready for Application

The superheater units are made of heavy, cold drawn seamless steel tubing of the proper diameter to give correct steam areas. The tubing is not covered with any other material and it thus presents a smooth external surface, offers minimum resistance to the flow of the gases and avoids serious collections of soot that would interfere with the efficiency and uniform operation of the superheater. This construc-

tion also brings the steam into intimate contact with the gas-touched heating surface, and gives a low resistance to the flow of heat from the gases to the steam.

The form of the unit is such as to permit free expansion and contraction of all parts. The tubes are bent on specially designed machines that do not weaken them or reduce the steam areas. Ample provision is made to prevent the pipes from warping. In cases where severe moisture and scale conditions are prevalent, the units can be made so that they may be satisfactorily cleaned on the inside. Due to the fact that the units are made of small diameter tubing, it is possible to obtain correct relations between steam areas and heating surface and so distribute the cross sectional area through the superheat as to obtain the most desirable steam velocity without the use of cores. The use of cores in super-



Ball Joint Connection Between Units and Header

heater tubes causes a considerable drop in pressure through the superheater, because of the added frictional resistance of the steam and where bad water and foaming occurs, the small space between the cores and the inside of the tubes is quickly stopped by scale-forming material.

The connection between the units and headers is a metal to metal joint. This joint is made so as to permit the easy removal of the units without special tools, and its use also avoids two holes in the header which would be necessary with rolled joints. Any unit in the superheater can be disconnected without interference with the other units, and the work of disconnecting a unit, which consists merely of loosening a bolt, can readily be done by the ordinary power plant attendant.

The ball end, as shown in the illustration, is formed integral with the tube by a special forging process. The ball is then faced and ground, and fits into a ground seat in the header, which is made at an angle of 45 degrees. The clamps and washers are made of forged steel, and the header bolts are made of heat-treated alloy steel, with an elastic limit of not less than 75,000 lbs., per square inch. This joint, while a new departure in stationary superheater design, has been used in a great number of locomotive superheater units and has withstood the extremely hard service of locomotive operation.

This superheater is suitable for application to all types of vertical or horizontal fire tube or water tube boilers and the possible fuel economy and increase in boiler efficiency make its use very desirable.

AN OPEN TYPE LOCOMOTIVE FEED-WATER HEATER

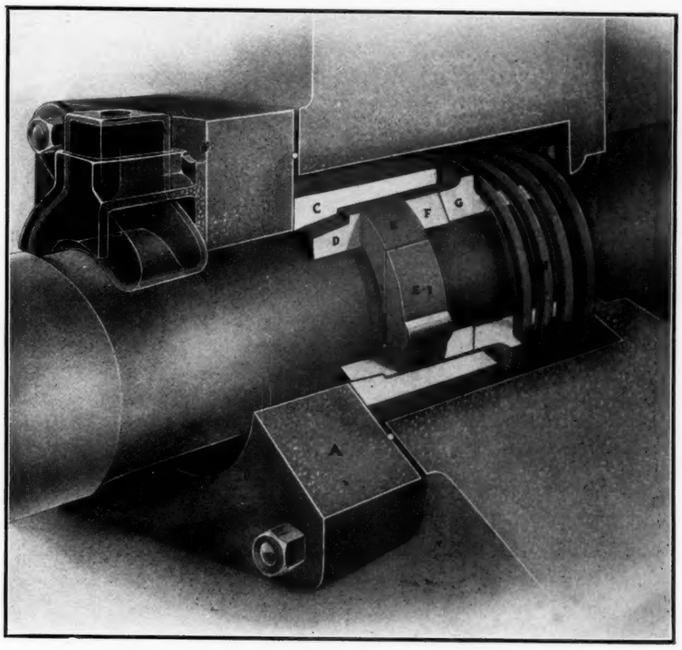
A typographical error in the description of the Worthington feedwater heater, which appeared on page 495 of the August issue, erroneously gave the capacity of the heater as 6,000 lb. of water per hour. This should have read 60,000 lb. of feedwater per hour.

Q & C PISTON ROD PACKING AND LUBRICATOR

The Q & C Packing & Lubricator Company, New York, is marketing a piston rod packing and lubricator.

THE Q & C PACKING

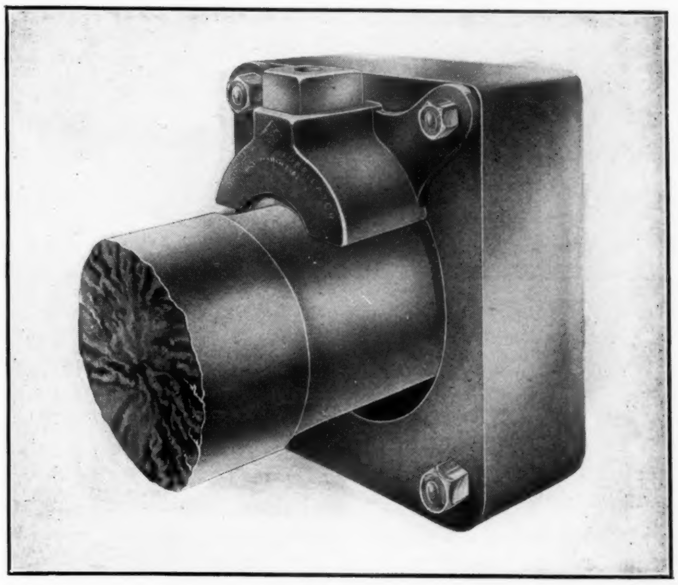
The packing is so designed that it is held tight against the rod by steam pressure, and the spring shown at the back serves only to hold the parts in place. By this means the wear



Piston Rod with the Packing and Lubricator Applied

of parts is practically limited to the time in which steam is actually used, thus greatly prolonging the life of the packing.

The cylinder head is bored out to sufficient depth and diameter to receive the packing. All of the parts of the



Application of the Piston Rod Lubricator

packing are made in two pieces with the exception of the retaining sleeve *C*. This is made in one piece and, in order to put it in place, the piston rod must be taken out of the crosshead. It is turned to slip easily into the cylinder head and bored out to take the retaining sleeve bushing *D*, the

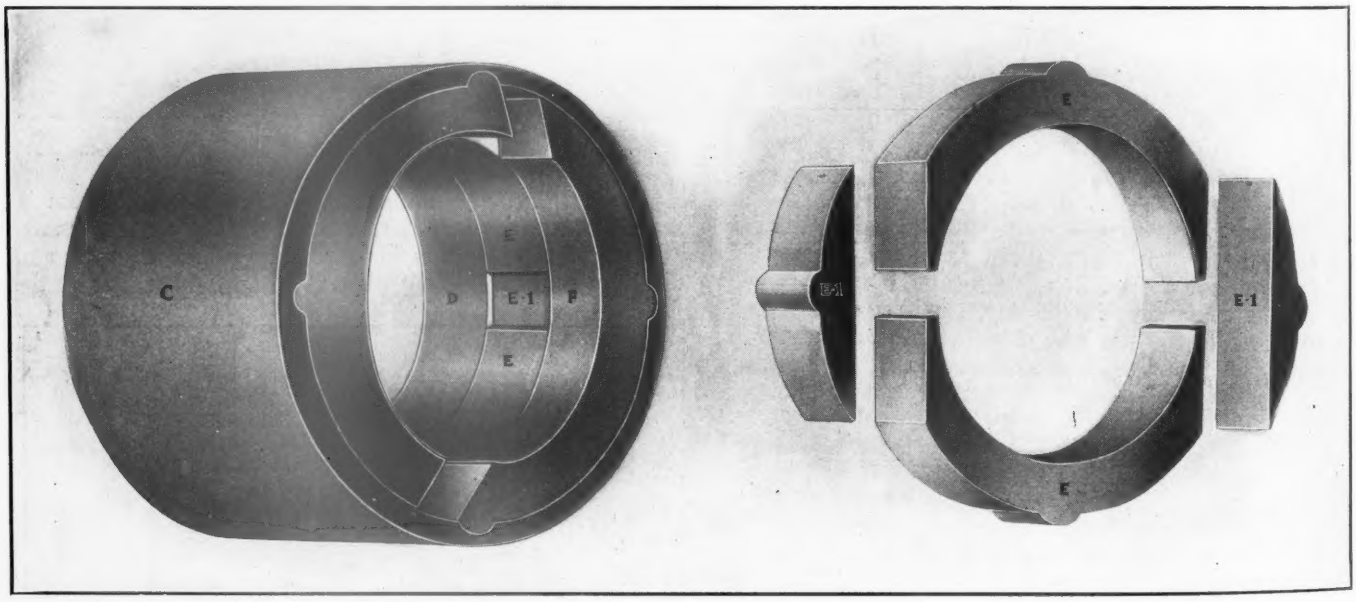
packing ring *E*, the packing shoe *E*-1 and the packing ring *F*.

These three sets of rings are made in sections. The parts *D* and *F* are made in two pieces each, and when the parts are brought together they can be entered in the sleeve and fit loosely on the rod. The parts *E* and *E*-1 are in two pieces each, so that four pieces are used to form the complete ring. The joints of the three sets of rings are made to break so that there is no longitudinal leakage of the steam.

The spring stop *G* has a bevel face bearing against *F* so that the latter is prevented from lifting the rod. The spring *H* has a tension only sufficient to hold the parts in place and prevent longitudinal movement under the action of the piston rod. The outward thrust of the spring passes through the rings to *D*, which is held by its lip bearing against the shoulder turned on the inner face of *C*, and *C* has a bearing against the gland *A*.

Steam enters the packing chamber from the cylinder and circulates freely over the rings, bushing and sleeve. The steam has the same access to the space between these parts and the piston rod, but as the outer surfaces of the rings are greater than the inner, the excess of pressure on those surfaces forces the parts against the rods and makes a tight joint. The instant the steam throttle is closed the pressure is relieved and the engine drifts without any pressure being exerted on the rod, so that the packing is purely steam actuated without the spring having any influence on the actual tightening of the parts.

Leakage of steam past the gland is prevented by a copper wire that is inserted between the gland and the cylinder head.



Details of the Piston Rod Packing Rings

THE Q & C LUBRICATOR

The lubricator shown in the illustration was designed to overcome the difficulties experienced with the ordinary cotton swab. This device consists of a brass shoe or cup held loosely within a retainer and free to adjust itself to the diameter and position of the piston rod, without appreciable wear on the rod. The hollow shoe is filled with lubricant and attached to the cylinder head as shown in the illustration. The use of this lubricator eliminates such trouble as glazing of the lubricating material or strands of the swabbing being drawn into the packing rings, thus causing steam leaks. The easy self-adjustment of the shoe insures long service and low cost of piston rod lubrication.

REGO WELDING AND CUTTING TORCHES

The Bastian-Blessing Company, Chicago, has developed torches for welding and cutting in which an original departure from existing apparatus has been made in the principle of mixing the gases. In these devices, which are known as the Rego torches, the acetylene is delivered at the mixing chamber under a pressure slightly greater than the pressure of the oxygen. With this arrangement the acetylene holds back any excess of oxygen under all conditions, thus eliminating the flashback which is a source of continual annoyance in most welding and cutting torches.

In the construction of the torch several innovations are introduced; no high pressures are used, the acetylene pressure even on tips larger than 1/8 in. being only 9 lb. In order to secure the correct volume of the gases, the mixing is accomplished in the tip so that the mixing chamber is changed each time that a different tip is applied. This form of construction facilitates repairs and reduces the volume of the mixed gases. The tip is of an alloy high in copper and is made without a thread and with a cone seat having a broad angle to prevent the tip sticking in the head.

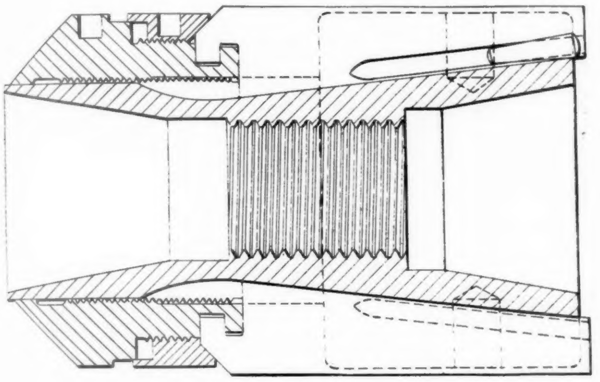
The cross section of the oxygen passage leading to the mixing chamber is of substantially the same cross section as the mixing chamber itself, while the acetylene passages have a cross section equal to approximately one-half the area of the mixing chamber. Both gases are delivered to the point where they mingle at a velocity higher than the rate of flame propagation in the mixture which will produce the neutral flame. The arrangement of the passages normally produces the neutral flame, and any obstruction of the tip will result in excess of combustible gas in the mixing chamber which reduces the rate of flame propagation at the point of mixing. Thus, if a condition is present which tends to cause a flashback the acetylene immediately shuts off the oxygen, automatically thus producing a rich mixture which will not backfire.

It is claimed that this torch positively prevents the flashback, thus eliminating the time wasted in relighting the torch. It is also claimed that it effects a marked saving in the gas consumption, insures a better quality weld and permits of employing less skilled labor than can be used with torches which do not employ the same principles of mixing the gases.

DAVIS EXPANSION REAMER

The old style of solid shell reamers have been in use for a long time, but with the constant improvement of other machine shop equipment, the necessity for a reamer whose blades could be expanded, to compensate for wear, has been keenly felt. To meet this situation the Davis Boring Tool Company, St. Louis, Mo., has developed the Davis expansion reamer. It is claimed that the design possesses all the advantages and eliminates all the disadvantages of the solid reamer.

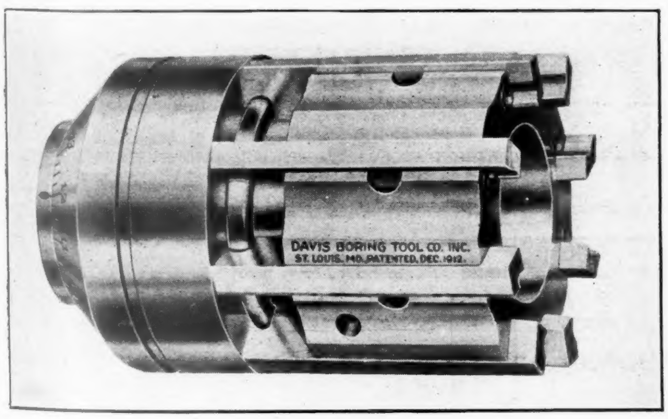
The distinguishing features of the Davis expansion reamer are simplicity and practical construction, with the minimum number of parts. The blades are positively controlled by an



Cross Section of Davis Expansion Reamer

accurate micrometer adjusting dial, graduated in quarter thousandths, which acts for both expanding and receding of blades. The blades are slotted and fit over the ring on the adjustable dial which prevents their movement either way, without turning the dial. When the reamer is set to the size required the blades are individually and doubly locked to the reamer body by a locking principle which positively locks the blades without the use of screws, virtually making a solid reamer.

The elimination of screws for holding the blades in a



Expansion Reamer Which Indicates Several New Features

reamer body is a distinct advantage. The blades are held with a special taper hardened and ground pin, which is fitted to the reamer body and to a groove in the blade resulting in a constant downward and lateral thrust that firmly holds the blades under all conditions. They are then clamped to the reamer body with the locking ring threaded on the adjusting dial, making it impossible to expand or recede the blades either by accident or carelessness without releasing the locking ring, which must be done before the expanding dial can be turned in either direction.

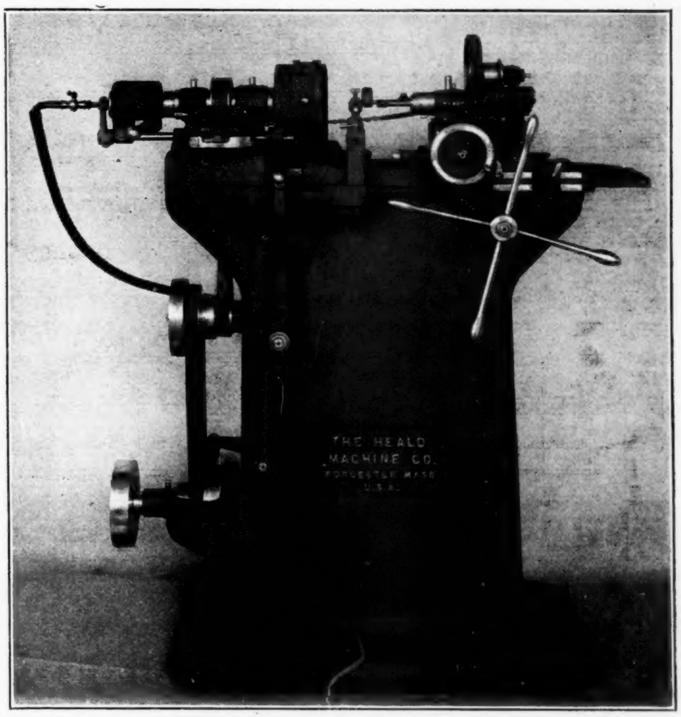
This reamer represents the first application of the forward movement of blades, for the purpose of expansion in a tool of this type. This feature always keeps the blades cutting in advance of the tool body, consequently the blades never lose their bottoming feature. The movement of the blades is positively controlled by the adjusting dial, which expands or recedes them. The blades have liberal expansion, with one-quarter thousandth adjustment and the locking of the blades is absolute and positive. Among the distinctive features of Davis expansion reamers is simplicity of driving which eliminates the necessity of making costly arbors. Any size can readily be applied without interfering with the driving shank. True alinement is assured when assembled in multiple form, virtually making a solid line reaming bar.

Blade efficiency and the cost of blades is an important factor which should be considered in connection with adjustable reamers. Davis expansion reamers require but three groups of blades to cover a range of sizes from 1⅝ in. to 6 in. inclusive. When the blades for a 6-in. reamer are worn under size they can be used in a number of smaller sizes down to and including 4 1/16 in. Blades for a 4-in. reamer can be used in smaller sizes down to 2½ in. Blades in a 2 7/16-in. reamer can be used in smaller sizes down to 1 ⅝ in. This wide range of adjustment permits of reaming the maximum number of holes per set of blades.

These tools are made either in the shell type or with a solid shank, straight or taper, to which a floating holder can be applied. All wearing parts are hardened and all threaded parts are protected from dust, chips or possible injury, which might result from careless usage or accident.

HEALD NO. 85 INTERNAL GRINDING MACHINE

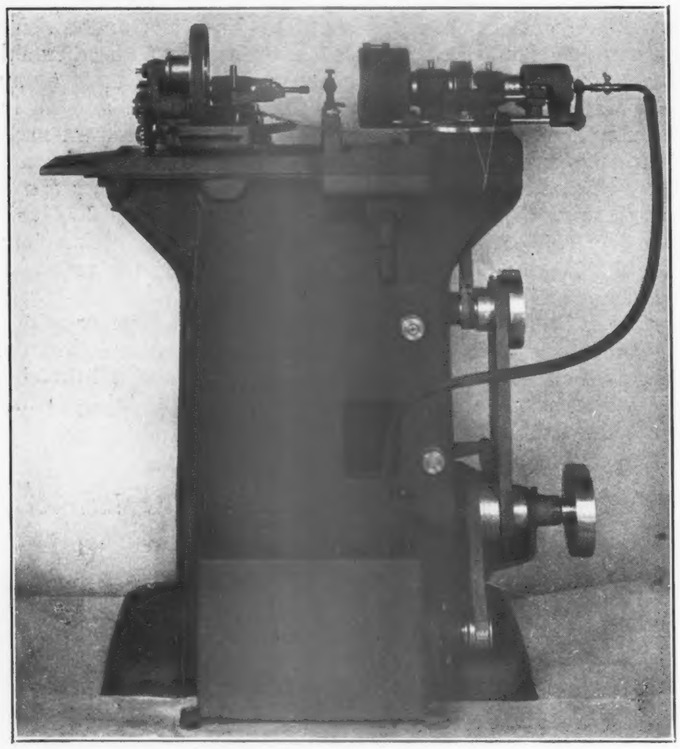
An internal grinding machine designed especially for small, short work is being made by the Heald Machine Company, Worcester, Mass. This machine is of simple design and is very strongly built. A conveniently located pilot



Front View of the Heald No. 85 Grinder

wheel furnishes hand feed movement to the table and a quick acting collet operated by a lever with an automatic brake to the working head, which also shuts off the water, reduces the chucking time to a minimum. The wheel heads

are of an entirely new design and have proved very successful. The working head is driven by a cross belt through the base from a four-step cone, giving three speeds of 161, 292 and 528 r. p. m. It is arranged to swivel and is graduated to permit 4-in. taper to the foot. The rotation of the working head is automatically stopped and the water shut off when the grinding wheel is withdrawn from the work. This is accomplished by means of a friction clutch in the base, operated by a lever on the front of the machine. As the table moves to the right a small dog attached to it engages the lever and throws the clutch out. To resume work the operator simply pushes the lever back into its vertical position, starting the working head and the water. The working head is bolted directly to the base of the machine and is fitted with adjustable dustproof bronze bearings. The working spindle is made of high grade steel, ground and lapped, the front bearing being 1⅝ in. in diameter and the rear bearing 1⅜ in. in diameter.



Rear View of the Grinding Machine

The holding fixture furnished with this machine consists of a quick-acting collet chuck with a capacity of ⅜ in. diameter up to 3 in. This is operated by a lever with an adjustable compensating device, which prevents distortion of the work. The feed to the cross slide is calibrated to one-quarter thousandths of an inch. The feed lever is at the left side of the cross slide, enabling the operator to keep his right hand on the pilot wheel while using his left hand to feed the slide. The main table has flat and "V" ways, and is extremely rugged for a machine of this size. It is provided with a positive stop accurately governing the travel, thus enabling the operator to grind up to a shoulder or any given point without danger of overrunning.

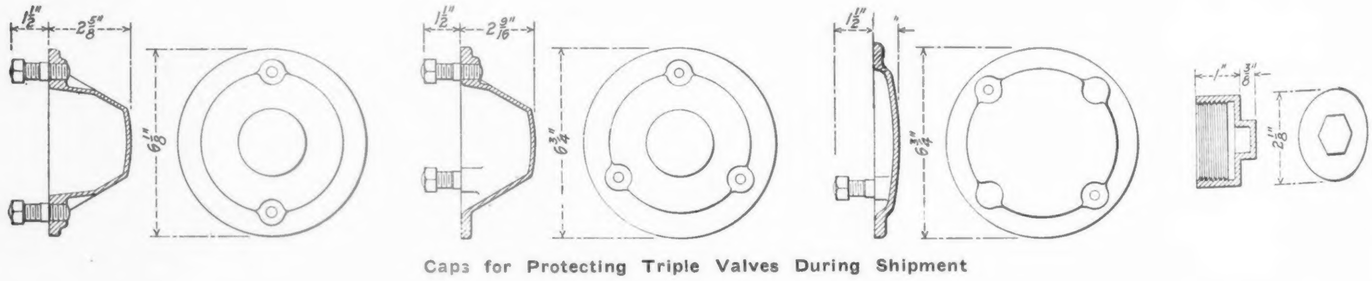
To reduce vibration to a minimum an overhead countershaft has been used. This shaft is of simple construction, having two steel hangers equipped with self-alining ball bearings, a driving pulley, a drum for the flexible idler and tight and loose pulleys to receive power from the main line, and it has a speed of 600 to 620 r. p. m. A wheel guard automatically covers the wheel as it is withdrawn from the work. This prevents injury to the operator's hand while plugging the work. The idler pulley is fitted with ball bearings and keeps an even tension on the spindle and countershaft belts at all times.

The water equipment includes a pump, tank, water guard and connections. The water tank and pump fit into the back of the base of the machine, requiring only a few more inches of floor space than the machine itself. This machine was designed for work ranging from ¼ in. to 2 in. in diameter by 4 in. long, and is especially adapted for use on holes smaller than ¾ in. in diameter by 1½ in. long. The actual swing inside the water guard is 6 in., while without the guard it is 10 in.

The machine is equipped with a wheel head having solid, adjustable taper bearings at the wheel end, with ball bearings at the pulley end. Another style of head is designed so that different sized quills may be inserted in the nose of the spindle. These quills are tapered which, when put in with a slight tap on the end of the quill, gives it a firm grip and practically makes it a part of the spindle. These heads are complete units in themselves, each having its own pulley, thereby securing correct spindle speeds.

SHIPPING CAPS FOR WESTINGHOUSE TYPE OF TRIPLE VALVES

Among the devices recently developed by the Westinghouse Air Brake Company, Wilmerding, Pa., are shipping caps for various types of triple valves. The illustrations show these caps which are designed to protect the cylinder flange end and the threaded check case connection of the valves during shipment. The caps were devised to meet an urgent demand for a protective device to be used in shipping triple valves from point to point on the railways and when returning them for repairs. Three caps constitute a set which takes care of all existing standard triple valves manufactured by the Westinghouse Air Brake Company. In the case of the type *H* and type *P* triple valve, two caps are required, one for the brake pipe connection in the check valve case after the union nut and swivel have been removed.



Caps for Protecting Triple Valves During Shipment

The caps are made of cast iron and are substantially proportioned to retain their shape and permit of being used an indefinite number of times. Studs as shown in the illustration are made an integral part of the casting, thus insuring that they will always accompany the caps. The bell portion is of proper size to provide clearance for the retarding device and the chucking threads on the *K* type triple valves.

Railway Mechanical Engineer

(Formerly the RAILWAY AGE GAZETTE, MECHANICAL EDITION with which the AMERICAN ENGINEER was incorporated)

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY

EDWARD A. SIMMONS, *President* HENRY LEE, *Vice President and Treasurer*
L. B. SHERMAN, *Vice-President* SAMUEL O. DUNN, *Vice-President*
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Chicago: Transportation Bldg. Cleveland: Citizens' Bldg.
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London: 85 Fleet Street, E. C. 4.
Subscription Agents for Great Britain and Egypt: The Dorland Agency, Ltd., 16 Regent Street, London, S. W. 1.
Cable Address: Urasigmech, London.

ROY V. WRIGHT, *Editor*
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Entered at the Post Office at New York, N. Y., as mail matter of the second class.

Subscriptions, including the eight daily editions of the Railway Age, published in June, in connection with the annual convention of the American Railroad Association, Section III—Mechanical, payable in advance and postage free: United States, Canada and Mexico, $2.00 a year; Foreign Countries, $3.00 a year; Single Copy, 20 cents.

WE GUARANTEE, that of this issue 11,400 copies were printed; that 10,174 of these 11,400 copies were mailed to regular paid subscribers, 20 were provided for counter and news company sales, 211 were mailed to advertisers, 28 were mailed to employees and correspondents, and 967 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 84,610, an average of 9,401 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

A company has been formed, says the Times (London) Trade Supplement, for the manufacture of special rolling stock for India which contains no wood.

Memberships in French labor unions have increased five-fold since the beginning of the war. At that time the French Labor Confederation had about 300,000 members. At the present time their membership has increased to about 1,500,000.

The Traveling Engineers' Association has announced that the question of the amalgamation of this association with Section III, Mechanical, of the American Railroad Association has been considered by a committee. Its findings will be presented at the convention which opens on September 16, at which time it is expected that the association will take definite action on the matter.

A pamphlet entitled Treatment of Industrial Problems by Constructive Methods is being sent to employers by the office of the director general, U. S. Department of Labor, with a chart showing the various subdivisions of the Department of Labor and the details handled by them. The working conditions service of the department is intended to offer a constructive plan for reducing industrial accidents and sickness and to render assistance in making better working conditions.

The contention that it is not always the inexperienced apprentice or helper who, through ignorance, adopts unsafe practices in his work, is made by George Bradshaw, supervisor of safety on roads under the jurisdiction of Federal Manager Frank H. Alfred in Educational Letter No. 18. Two instances are cited in support of this contention, one a case where a machinist who was reaming out holes with a hardened steel reamer struck the hardened end of the reamer with a hammer to make it go into the hole before putting the wrench on it. A piece of steel flew off and struck him in the eye, but fortunately the injury was slight. The second case was that of the workman who was about to cut off a file in a shear when one of his fellow workers stopped him.

A controversy among machinists arose on the St. Louis-San Francisco because of the appointment of W. J. Foley as general roundhouse foreman at North Springfield, Mo., and strike ballots were sent out. The contract between the company and the machinists states that a machinist shall be placed over machine men, and it is this clause of the contract that the men claimed had been violated in the appointment of Mr. Foley, who was formerly a locomotive engineer. He was later promoted to road foreman of engines and then was acting assistant superintendent in the operating department until the return of the assistant superintendent from government service. In defense of the appointment of Mr. Foley, officers of the road say that no portion of the contract between the machinists and the company has been violated, because the duties of the general foreman cover not only machinists but boilermakers, pipefitters, electricians, tank men and miscellaneous repairmen as well as engineers and firemen. Mr. Foley has been a member of the Brotherhood of Locomotive Engineers.

Steam vs. Electrical Working of Locomotives

An abstract by the Technical Supplement of the Review of the Foreign Press from an article in the Zeitschrift des Oesterreichischen Ingenieure und Architekten-Vereines, states that the railways of German-Austria only use about one-tenth of the entire coal consumption of the country. Details of the coal consumption are given, pointing out that with the modern superheaters the locomotive has become much more efficient than formerly. Steam locomotives are stated to work more efficiently than electric locomotives especially where goods trains are concerned; and even in Switzerland the cost per ton-kilometer on the electric railways is often higher than on the railways worked by steam. The whole argument is to the effect that only under certain conditions will electrical working prove cheaper than steam working.

Classification of Technical Employees in the Northwestern Region

A definite step toward the classification of technical employees of the engineering, mechanical, land and valuation departments was recently made in the Northwestern region through the issuance of a communication by R. H. Aishton, regional director, to the federal managers of railways in the Northwestern region for their information and guidance. This schedule is of particular interest because of the detail in which the duties, responsibilities, degree of technical training and extent of experience are

treated in defining each classification. The statement covers positions in the engineering, mechanical, land and valuation departments below the grades of assistant engineer and chief draftsman, and the definition of each grade includes a salary rating giving the maximum and minimum limits of salary comparable to the character of services rendered in each grade.

Authority is given to apply this classification as effective July 1, 1919. No overtime is to be allowed men covered in this classification.

The schedule for the five classes of particular interest to the mechanical department is as follows:

DRAFTSMEN, CLASS 1, $200-225

On general or special duty, requiring special knowledge, training and experience, and a special degree of initiative and originality, thoroughly competent, engaged regularly in the design and general direction of the design of large and difficult work on yards and terminals, track details, etc., or steel, concrete and timber bridges and structures, or special buildings, etc., or locomotives, cars, special machinery, mechanial and electrical power plants, etc.

DRAFTSMEN, CLASS 2, $175-190

On general or special duty, requiring special knowledge or training and experience and the use of initiative and originality. Engaged in the general designing and the direction of detailing of plans of yards and terminals, track details, etc., or steel, concrete, or timber bridges and structures, or special buildings, power plants, etc., or locomotives, cars, special machinery, or signals and signal apparatus, or land, right-of-way and valuation maps and profiles from field notes and records.

DRAFTSMEN, CLASS 3, $150-165

On general or subordinate duty, requiring special knowledge or training, experience and initiative, generally engaged in the designing and detailing of work in accordance with standard practices, and the direction of work of a minor character on right-of-way maps, mileage records, or steel, concrete and timber bridges and structures, or locomotives, cars, special machinery, mechanical and electrical power plants, or signals and signal apparatus, or land, right-of-way and valuation maps and profiles from field notes and reords.

DRAFTSMEN, CLASS 4, $125-140

On subordinate duty requiring a certain amount of knowledge, training or experience, and engaged generally in detailing, compiling and recording general engineering plans, land and right-of-way maps, or valuation maps and profiles, or records of bridges, buildings, locomotives, cars or signals.

TRACERS, $100-120

On subordinate duty requiring a certain amount of experience or knowledge of drafting. Capable of doing neat, accurate and rapid work.

MEETINGS AND CONVENTIONS

Chief Interchange Car Inspectors' and Car Foremen's Association.—The nineteenth annual convention of this organization will be held on September 23, 24 and 25, 1919, at the Planters Hotel, St. Louis, Mo.

The Traveling Engineers' Convention.—The Railway Equipment Manufacturers' Association announces that 65 firms have already arranged for space at the exhibit which will be held in connection with the convention of the Traveling Engineers' Association at the Hotel Sherman, Chicago, on September 16, 17, 18 and 19.

Foundrymen's Association Convention.—The annual convention of the American Foundrymen's Association will be held at the Commercial Museum, Philadelphia, September 29 to October 3. In connection with this convention there will be one of the most extensive exhibits of machine tools and shop devices ever displayed. Over 200 companies will be represented, among them a large number whose products are widely used in railroad shops.

Steel Treaters Society.—The first convention of the American Steel Treaters Society will be held in the Seventh Regiment Armory, Chicago, September 23 to 27, inclusive. The sessions will be held in the morning, afternoon and evening. An extensive exhibit is planned in connection with the meeting. Among the subjects covered by the papers will be the selection of steel, the design of tools, the heat treatment of steel for various purposes, case hardening, and equipment for heat treating. The papers are intended to cover the latest practice in every branch of the art of heat treating and are prepared by recognized experts. Non-members as well as members of the society may attend the meetings and join in the discussions.

The following list gives names of secretaries, dates of next or regular meeting, and places of meeting of mechanical associations:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD ASSOCIATION, SECTION III—MECHANICAL.—V. R. HAWTHORNE, 431 South Dearborn St., Chicago.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawler Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, secretary, Federal Reserve Bank Bldg., St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—H. J. Smith, D. L. & W., Scranton, Pa. Convention September 23-25, Planters Hotel, St. Louis, Mo.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention September 2-5, 1919. Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Convention, September 16-19, Hotel Sherman, Chicago.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	....	....	....	James Powell	P. O. Box 7, St. Lambert, Que.
Central	....	....	....	H. D. Vought	95 Liberty St., New York.
Cincinnati	Sept. 9	Locomotive Construction	W. A. Austin	H. Boutet	101 Carew Building, Cincinnati, O.
New England	Oct. 14	....	....	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Sept. 19	Purchasing and Stores Organizations	H. B. Spencer	H. D. Vought	95 Liberty St., New York.
Pittsburgh	Sept. 25	Economic Disposal of Waste Material	C. H. Clark	J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	Sept. 12	The Railroad Question of Today	Dr. Wm. G. Raymond	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Sept. 15	Electric Car Lighting	E. Wanamaker	J. M. Byrne	547 West Jackson Blvd., Chicago.

PERSONAL MENTION

GENERAL

LIEUT. LEIGH BUDWELL has resumed his duties as mechanical engineer of the Richmond, Fredericksburg & Potomac and the Washington Southern, with headquarters at Richmond, Va., having just returned from 12 months' service in the Transportation Corps in France, where he served as master mechanic in the 16th Grand Division. B. J. Coffman, who has been acting mechanical engineer during the absence of Lieutenant Budwell, has been assigned to other duties in the mechanical department.

S. D. DIMOND has been appointed chief electrician on the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at St. Paul, Minn., succeeding J. R. Smith, who has been appointed signal supervisor.

B. F. KUHN, master mechanic on the New York Central lines west of Buffalo, with office at Ashtabula, Ohio, has been appointed assistant superintendent of motive power, with headquarters at Cleveland, Ohio.

HERMAN F. NOYES, whose appointment as superintendent of fuel economy of the Maine Central and the Portland Terminal with office at Portland, Me., was announced in the July issue of the *Railway Mechanical Engineer,* was born on August 1, 1877, at Freeport, Me., and was graduated from the University of Maine in 1899. He began railroad work on March 4, 1902, as a fireman on the Maine Central, being promoted in August, 1906, to the position of assistant air brake inspector and in February, 1907, air brake inspector. He was appointed motive power inspector on August 4, 1913, his title being changed in June, 1918, to traveling engineer, and served in that capacity until his appointment recently as superintendent of fuel economy.

H. F. Noyes

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

F. M. CRANDALL, assistant master mechanic on the New York Central lines west of Buffalo, at Collinwood, Ohio, has been appointed master mechanic, with headquarters at Ashtabula, Ohio, and has jurisdiction over the Franklin division, including the Oil City branch, the Franklin & Clearfield branch, Ashtabula and Youngstown yards, and the Alliance division.

PURCHASING AND STOREKEEPING

J. D. EAST has been appointed division storekeeper of the Baltimore & Ohio Eastern Lines, with headquarters at Keyser, W. Va., succeeding C. S. Filler, resigned.

G. H. GREER, storekeeper on the Yazoo & Mississippi Valley, with headquarters at Vicksburg, Miss., has been appointed storekeeper for the Gulf, Mobile & Northern, at Mobile, Ala., succeeding R. C. Brown, resigned.

SHOP AND ENGINEHOUSE

H. H. MAXFIELD, whose appointment as acting works manager of the Pennsylvania Railroad, Eastern Lines, with office at Altoona, Pa., was announced in the June issue of the RAILWAY MECHANICAL ENGINEER, has been appointed works manager. He has charge of the Altoona shops, comprising the Altoona machine shops, the Altoona car shops, the Juniata shops and the South Altoona foundries, and reports to the general superintendent of the Eastern Pennsylvania division. Mr. Maxfield was born in 1873 and was educated at Stevens Institute. He entered the service of the Pennsylvania Railroad on September 5, 1885, as an apprentice in the Meadow shops. On August 1, 1899, he became machinist and in March, 1900, inspector and gang leader. He was promoted in December, 1902, to assistant master mechanic at the Pavonia shops of the Trenton division and in April, 1903, was appointed assistant engineer of motive power of the New Jersey division at Jersey City. On April 1, 1905, he was appointed master mechanic of the Trenton division and in July, 1911, was transferred to the Pittsburgh division in the same capacity. On May 1, 1916, he was promoted to superintendent of motive power of the Western Pennsylvania division and about June, 1917, was transferred to the New Jersey division, with office at New York. In July, 1917, he was granted a furlough to enter military service as an officer in the Ninth Engineers, and while in France he was superintendent of motive power of the Transportation Corps, American Expeditionary Force.

H. H. Maxfield

OBITUARY

GEORGE J. DUFFEY, superintendent of motive power of the Lake Erie & Western, with headquarters at Lima, Ohio, died at his home in that city on August 16. He was born at Clinton, Ont., Canada, on May 24, 1863, and began railway work as an apprentice on the Michigan Central at St. Thomas, Ont., and served later as roundhouse foreman and general foreman on that road. In 1907 he left the service of the Michigan Central to go to the Chicago, Indiana & Southern as general foreman at Gibson, Ind. On June 1, 1908, he was appointed superintendent of shops of the Lake Erie & Western at Lima, Ohio; on November 1, 1908, was promoted to assistant master mechanic and in March, 1911, was again promoted to master mechanic. Since January 1, 1916, he served as superintendent of motive power on the same road.

HARRY H. HILBERRY, master mechanic of the Eastern division of the Pennsylvania Lines West of Pittsburgh, with headquarters at Pittsburgh, Pa., died in that city on August 5, aged 50 years.

W. H. WATKINS, master mechanic on the Illinois Central at Memphis, Tenn., who was granted a leave of absence in the early part of this year, died at his home in Memphis on August 22, at the age of 50.

SUPPLY TRADE NOTES

George J. Lynch has been appointed sales manager for the Youngstown Steel Car Company, with headquarters at Youngstown, Ohio.

The Page Steel & Wire Company, New York, has opened a branch office at 29 South LaSalle street, Chicago, and another in the Book building, Detroit.

The Falls Rivet Company, Kent, Ohio, is preparing plans for the construction of a new building at Kent. It is probable that work on the new structure will not begin before early spring.

The Schroeder Headlight & Generator Company, Evansville, Ind., has appointed S. Herbert Lanyon as its representative on the Pacific coast, with office at 507 New Call building, San Francisco, Cal.

The Chicago Railway Equipment Company, Chicago, is completing plans for the reconstruction of that part of its plant which was damaged by fire on August 2. About $25,000 will be expended on the work.

J. L. Canby has been appointed district manager of sales of the Chicago Pneumatic Tool Company, Chicago, with offices at Chicago, succeeding Nelson B. Gatch, who has been transferred to the New York office.

A. E. Braun, president of the Farmers Deposit National Bank, Pittsburgh, Pa., has been elected a director of the Pressed Steel Car Company, New York, to fill the vacancy caused by the death of T. H. Given.

Earle W. Vinnedge has received his discharge from the military service and has been appointed sales engineer for the Worthington Pump & Machinery Corporation, New York, with headquarters at Cincinnati, Ohio.

T. L. Dodd & Co., Railway Exchange building, Chicago, have been appointed western sales representatives of the Worth Steel Company, Claymont, Del., manufacturers of fire box steel plates, boiler and tank plates.

L. H. Elliott has been elected vice-president and secretary of the Upson Nut Company, Cleveland, Ohio, succeeding Norris J. Clarke, who has resigned. Mr. Elliott will retain his former position as secretary and treasurer of the Bourne-Fuller Company, Cleveland.

The Anglo-Saxon Trading Corporation, 114-A Pitt street, Sydney, Australia, advises through its New York office that it desires to receive catalogues and full particulars from manufacturers of all kinds of devices relating to the mechanical side of railway transportation.

James M. Monroe has resigned as representative of the Southeastern territory of the Hunt-Spiller Manufacturing Corporation, Boston, Mass., to become vice-president of the Harry Vissering Company, Chicago, and vice-president of the Charles R. Long, Jr., Company, Louisville, Ky.

Herbert Duckworth has been appointed sales manager of the grinding wheel division of the Norton Company, Worcester, Mass.; Howard W. Dunbar has been appointed sales manager of the grinding machine division; John C. Spence, superintendent, and Charles H. Norton chief engineer.

W. Terry Field, constructing engineer for the American Car & Foundry Company, New York, with office at Detroit, Mich., has resigned to form a partnership with John R. Fordyce, formerly Major and Construction Quartermaster at Camp Pike, Ark. The new firm will be known as Fordyce & Field, consulting and construction engineers, Little Rock, Ark.

The Railway Motor Car Company of America, Chicago, plan to construct a manufacturing plant at Hammond, Ind., at an approximate cost of $80,000. The building will be 300 ft. long by 100 ft. wide, 50 ft. of which will be two stories high. The superstructure will be of brick construction.

E. T. Sawyer has been appointed a representative of the railway sales department of the U. S. Light & Heat Corporation, Niagara Falls, N. Y. Mr. Sawyer will specialize on car lighting equipment and electric car welders and will have his headquarters at 30 East Forty-second street, New York City.

The Rickert-Shafer Company, Erie, Pa., is making plans for the erection of another wing to the factory building, 33 ft. by 150 ft., two stories high, of steel and brick construction, in order to take care of the increased demand for Boehm automatic die heads and R & S tapping machines. The company is also about to place several new tools on the market.

F. O. Slutz has been appointed manager of the railway sales department of the B. F. Goodrich Rubber Company, Akron, Ohio, succeeding C. M. Woodruff, who has resigned to accept a position with the Akron Board of Education. Mr. Slutz was born on April 29, 1883, and received a high school education. He entered the service of the B. F. Goodrich Rubber Company, on October 24, 1901. In 1909, he served as a clerk in the pneumatic tire sales department and the following year was transferred to the railway sales department, where he served in various positions, giving most of his attention in recent years to railway sales work exclusively, until his appointment as manager of the same department. Mr. Slutz will have his headquarters at Akron, Ohio.

F. O. Slutz

Captain Thomas O'Leary, Jr., of the Fifty-First Engineers, has returned to the service of the New York Air Brake Company, New York, as western representative on lines west of the Missouri river. Captain O'Leary was adjutant of the Touraine division of the Fourteenth Grand division, Camp De Grasse, France, operating the French railroad out of that place.

The Ryan Car Company, Chicago, is constructing an all-steel, steel car plant 90 ft. by 600 ft., upon a recently acquired 50-acre tract one-half mile east of its old plant at Hegewisch, Ill. In addition to the main plant three smaller buildings are being constructed. It is expected that operation will begin in the fall. The approximate cost of the new buildings with new equipment will be $350,000.

F. B. Hartman has been appointed representative of the Hunt-Spiller Manufacturing Corporation, Boston, Mass. He is to cover the southeastern district, succeeding J. M. Monroe, who has resigned to become vice-president of the Charles

H. Long Company. Previous to 1906 Mr. Hartman was in the service of the Union Pacific and later was with the Southern Railway, part of the time as general equipment inspector.

The Onondaga Steel Company, Inc., Syracuse, N. Y., is making plans for building several new additions to the plant at James street and Thompson road, Syracuse, in 1920. To carry out this program the capitalization of the company has been increased from $150,000, to $1,000,000. The new building program calls for an annealing plant 160 ft. by 40 ft., an 80-ft. extension to the present mill building and several other buildings.

American Car & Foundry Company

The directors of the American Car & Foundry Company, New York, having recently abolished the office of general manager, James M. Buick, formerly vice-president and general manager, has assumed the direction of the sales division of the company and will be known as vice-president in charge of sales.

W. C. Dickerman

The production division will be directed by William C. Dickerman, who will be known as vice-president in charge of operations. He will be assisted by Frederick A. Stevenson, as assistant vice-president in charge of operations, who will be head of the manufacturing section and have charge of production in the car plants, rolling mills and foundries, also supervision over the engineering improvement and research, patent and industrial relations sections. The headquarters of both divisions will be at the general offices, 165 Broadway, New York. Mr. Dickerman, as head of the war division, and Mr. Stevenson, as his assistant, directed the company's recent program in the manufacture of munitions for the government of the United States and its allies.

F. S. Stevenson

William C. Dickerman was born on December 12, 1874, at Bethlehem, Pa. After a preparatory course at William Penn Charter School, Philadelphia, he was graduated from Lehigh University in 1896, with the degree of mechanical engineer. Mr. Dickerman entered the employ of the Milton Car Works, Milton, Pa., in 1897, and when the American Car & Foundry Company was organized he was made assistant district manager for the Milton district. In 1900 he became sales agent of the company and in 1905 was elected to the vice-presidency.

Frederick A. Stevenson was born on April 6, 1880, at Detroit, Mich. After completing the high school course, he entered the employ of the American Car & Foundry Company in 1899, as an apprentice in the machine shop at the Detroit plant. In 1902 he was transferred to the Berwick plant and served as master mechanic in charge of all mechanical work in the steel car department, and in 1907 he returned to Detroit to assume a similar position in the company's plant. In 1909 he entered the assistant general manager's department at Chicago and carried on the development of new ideas and methods until October, 1910, when he became assistant general superintendent of the Detroit plant. In 1912 Mr. Stevenson was made general superintendent at Detroit and held this position until January, 1916, when he was appointed assistant general manager.

J. Leonard Replogle, president of the American Vanadium Company, New York, also president of the Wharton & Northern Railroad and chairman of the board of directors of the Wharton Steel Company, who, during the period of the war was director of steel supplies for the War Industries Board, has had conferred upon him by the French government the decoration of Chevalier of the Legion of Honor, in recognition of services rendered by him in the Allied cause during the war.

The Schroeder Headlight & Generator Co., Evansville, Indiana, announce the opening of two new offices. One of these offices, in charge of Harlow A. Varney, district sales manager for the company, is located at 1051 McCormick building, Chicago. The second office, at 507 New Call building, San Francisco, will be the headquarters of S. Herbert Lanyon, district sales manager for the Pacific coast territory. Both Mr. Varney and Mr. Lanyon have had a number of years experience in the railway supply business.

Roland S. Lebarre, assistant manager of sales for the Cleveland, Ohio, district of the Carnegie Steel Company, Pittsburgh, Pa., has resigned to become general sales manager of the alloy steel department of the Interstate Iron & Steel Company, Chicago. He began his business career 20 years ago with the United States Steel Corporation and in 1902 entered the sales department of the Illinois Steel Company. During the past 14 years he has been assistant district manager of sales for the Carnegie Steel Company, at Cleveland.

The Duff Manufacturing Company, Pittsburgh, Pa., is constructing an addition of 160 ft. by 80 ft., to its works at Pittsburgh. The new building is of brick and steel and is designed to accommodate the forge shop and heat treating department. Provision has been made for installing 16 steam hammers, with an equal number of trimming presses. The heat treating department will be equipped with furnaces of the latest type, burning either oil or gas. The completion of the new forge shop, about October 1, will make possible a large increase in the production of Duff jacks.

At the annual meeting of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., on August 13, the following directors were elected: R. C. Caples, E. H. Gold, J. E. Kepperley, C. L. Lane, C. O. Miniger, J. O. Moore, B. J. O'Reilly, J. A. Roberts, G. G. Shepard, J. Allan Smith and J. N. Willys; and the following officers were elected for the ensuing year: John N. Willys, chairman of the board of directors; E. H. Gold, vice-chairman of the board of directors; J. Allan Smith, president; C. L. Lane, vice-president and general manager; R. C. Caples, vice-president; B. J. O'Reilly, treasurer; R. H. Van Nest, secretary, and T. G. Swannie, assistant secretary and assistant treasurer.

The Chicago Pneumatic Tool Company, Chicago, is now erecting a 10-story office building at 6-8 East Forty-fourth street, New York, in which will be housed its general offices now at Chicago. The new building will be completed early

in 1920. The structure will be of steel, brick and limestone construction and will be occupied solely by the offices of the company. The ground floor will contain a permanent exhibition room and display of its pneumatic and electric drills and other tools, gas engines, air compressors, etc. A completely equipped service station will also be maintained. The six American plants and 26 sales and service branches will be directed from New York. A sales and service organization will be maintained in Chicago on a more extensive scale than formerly.

George H. Richie, sales engineer in New England and Eastern Canada for the Sullivan Machinery Company, Chicago, has been promoted to New England sales manager, succeeding George Elmer Wolcott, deceased. R. S. Weiner has been appointed district manager with headquarters at El Paso, Tex., in place of Don M. Sutor, who has been transferred to the St. Louis, Mo., office as sales manager for Missouri, Arkansas, eastern Texas, Oklahoma, Kansas (except the oil territory), western Kentucky and western Tennessee. Phillips S. Jarvis has resigned as sales manager for the territory controlled from the St. Louis office and Marion C. Mitchell has been appointed sales manager for the territory in Indiana and Illinois previously controlled from the St. Louis office, with temporary headquarters at St. Louis. Daniel H. Hunter has been appointed sales manager for Louisiana, Texas (except the southwestern section), and the oil fields of Oklahoma and Kansas with headquarters at Dallas, Tex.

The housing facilities of the Westinghouse Air Brake Company, Wilmerding, Pa., are to be extended at once by the erection of a number of new dwellings, for the families of employees. The Westinghouse Air Brake Home Building Company has been organized with a capital of $1,000,000 to transact all business relative to the real estate and dwellings, which have been transferred by deed to this company by the Westinghouse Air Brake Company. It includes over 400 houses and considerable vacant property in the borough of Wilmerding and adjacent territory. The officers of the new organization are A. L. Humphrey, chairman of the board of directors; C. A. Rowan, president; W. S. Bartholomew, vice-president, and H. C. Tener, secretary. In addition to the first three mentioned above J. F. Miller and G. W. Wildin are included in the board of directors. S. R. Gittens has been appointed manager. Since the Westinghouse Air Brake Company built its first houses for employees in 1890 there has never been an increase in rents and the new company will carry out the same policy.

The Detroit Seamless Steel Tubes Company has begun construction of a $3,000,000 plant on a 60-acre tract at Detroit, Mich. The first unit of the plant will cost $1,000,000 and will be completed by January 1, 1920. The building plans call for a structure of steel and glass with brick and concrete facing. The plant proper will occupy a space of 350 ft. by 700 ft. It will consist of three bays for manufacturing units, a separate heating plant and a two-story administration building. The three manufacturing units will be each 90 ft. wide, by 700 ft. and 550 ft. long and 45 ft. high, to permit the use of traveling cranes and other labor saving machinery. The interior layout and special tube mill machinery was designed under the direction of C. A. Ross, consulting mechanical engineer, and C. L. Stafford, mill superintendent. The plant will be equipped with the latest types of modern labor saving devices and machines, and a powdered coal system will be used for all the heating and annealing processes used in manufacturing operations. The total capacity of the first unit of the new plant will be 2,500 tons of seamless steel tubing a month, the range of sizes being from one-half inch to six inches outside diameter, and No. 13 gage and heavier.

CATALOGUES

Window Fixtures.—Catalogue W-19 of the O. M. Edwards Company, Inc., Syracuse, N. Y., contains 64 pages and should prove of practical value to car designers. It contains considerable detailed information about the fixtures and the service for which the various designs are best adapted and by means of drawings clearly shows their application to single and double sash windows. All of the detail parts, such as sash balances and brackets, sash locks, racks and lifts, compression devices and weather stripping, are shown in numerous sketches and photographs.

Welding Rods and Wire.—A small booklet of 60 pages has been published by the Page Steel & Wire Company, New York, which contains a large amount of useful information on welding and welding materials and describes the method of manufacturing Armco iron rods and wire for oxy-acetylene and electric welding, illustrated with microphotographs showing the structure of the material used. The booklet contains a large number of other illustrations and data in tabular form, including a table showing the diameter of rods to be used on various thicknesses of metals to be welded, temperature and metric conversion tables and data regarding the properties of elements and metal compositions, etc.

Texaco Lubricants.—The series of advertisements of the Texas Company, New York, entitled "How Texas Jones Convinced the Railways," which has appeared in the *Railway Mechanical Engineer*, has been reprinted in a booklet of 39 pages, 9 in. by 12 in., issued by the Texas Company. Thirty pages each contain a record in dialogue form, with illustrations, of imaginary meetings of a railroad purchasing board, showing the evidence brought by "Texas Jones" and others to convince the railways of the value of using Texaco lubricants. In addition the book contains a list covering four pages of railroad products made by the Texas Company.

Steel Tanks and Boilers.—A cloth bound book of 96 pages, 6 in. by 9¼ in., has been published by the Coatesville Boiler Works of Coatesville, Pa., manufacturers of steel tanks for a large variety of uses, A. S. M. E. boilers, stacks, open hearth furnaces, blast furnaces, cement kilns, regenerators, etc., to show the vast scope of the business and the great variety of heavy steel plate work manufactured in the shops of this company. This is indicated in over 100 illustrations. Included in the book are the specifications for steam boilers formulated by a committee appointed by the American Society of Mechanical Engineers, in accordance with which Coatesville boilers are made. The book is designated as General Catalogue No. 24.

Steam Pumps.—Several bulletins have been issued by the A. S. Cameron Steam Pump Works, New York, describing their pumps, which are bound together in a heavy manila folder. Included among these are Bulletin 7204, which explains the general characteristics and operation of Cameron steam piston and plunger pumps; bulletin 7152, showing the construction of a single suction volute centrifugal pump, with tables of capacities, speeds and horsepowers; bulletin No. 7251, covering two-stage motor driven and three-stage turbine driven centrifugal pumps and giving complete information regarding their operation, specifications and detail parts; and bulletin 7150, describing and illustrating the general design of a double suction volute centrifugal pump, including the results of tests made with this pump and useful information regarding the friction and pressure of water.